FINAL

TMDLs for Dissolved Oxygen and Nutrients in Selected Subsegments in the Upper Terrebonne Basin, Louisiana

(120110, 120102, 120103, 120105, 120106, 120107, 120109)

Prepared for:

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Water Quality Protection Division
Permits, Oversight, and TMDL Team
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EXECUTIVE SUMMARY

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for impaired waterbodies. A TMDL establishes the amount of a pollutant that a waterbody can assimilate while still meeting the water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody, and it may include a future growth (FG) component. The TMDL components are illustrated using the following equation:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS + FG$$

The study area for this TMDL includes seven upper Terrebonne Basin subsegments. The upper Terrebonne Basin is in Point Coupe, Iberville, and West Baton Rouge Parishes. The predominant land use in the impaired subsegments is wetland. The percentage of wetlands in the watersheds ranges from 23.5 percent to 95.4 percent followed by cultivated crops, pasture/hay, and developed. Heavy rainfall events typically occur in March and April as frontal weather systems pass through.

The Louisiana Department of Environmental Quality (LDEQ) has included seven upper Terrebonne Basin subsegments on the state's 2004 section 303(d) list of impaired waterbodies. The subsegments are listed for dissolved oxygen and nutrient impairments. The impaired designated uses for the subsegments (Table ES-1) are primary and secondary contact recreation (PCR and SCR), and fish and wildlife propagation (FWP). The subsegments are either fully supporting (F) or not supporting (N).

Table ES-1. Section 303(d) listing for subsegments included in this report

Subsegment	Subsegment name	Subsegment description	Designated use		
			PCR	SCR	FWP
120102	Bayou Poydras	Headwaters to Bayou Choctaw	N	F	N
120103	Bayou Choctaw	Bayou Poydras confluence to Bayou Grosse Tete	F	F	N
120105	Chamberlin Canal	Chamberlin to Bayou Choctaw	N	N	N
120106	Bayou Plaquemine	Plaquemine Lock to ICWW	F	F	N
120107	Upper Grand River and Lower Flat River	Headwaters to ICWW	F	F	F
120109	Intracoastal Waterway	ICWW Morgan City to Port Allen Route: Port Allen Locks to Bayou Sorrel Locks	N	F	N
120110	Bayou Cholpe	Headwaters to Bayou Choctaw	F	F	N

A water quality model (LA-QUAL) was set up to simulate dissolved oxygen, 25-day carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and nitrite+nitrate. The model was calibrated using data from fieldwork conducted in July 2006. The projection simulation was run at critical flows and temperatures to address seasonality, as the Clean Water Act requires. Reductions of existing point source and nonpoint source loads were required for the projection simulation to meet the dissolved oxygen standard, 5 milligrams per liter (mg/L). In general, the modeling in this study was consistent with guidance in the Louisiana TMDL technical procedures manual (LDEQ 2005). TMDLs for oxygen-demanding substances ($CBOD_u$, ammonia, and sediment oxygen demand [SOD]) were calculated using the projection simulation.

In TMDL development, allowable loads from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls. WLAs were assigned to permitted point source discharges. The LAs include background loadings and human-induced nonpoint sources. An explicit MOS of 10 percent and an FG component of 10 percent were also included.

The dissolved oxygen TMDL establishes load limitations for oxygen-demanding substances and goals for reducing those pollutants. When oxygen-demanding substances are controlled and limited to ensure that the dissolved oxygen criterion is supported, nutrients are also controlled and limited. Implementing the dissolved oxygen TMDL through future wastewater discharge permits, if required, and implementing best management practices to control and reduce runoff of soil and oxygen-demanding pollutants from nonpoint sources in the watershed will also control and reduce the nutrient loading from those sources.

Table ES-2 presents a summary of the dissolved oxygen TMDLs for the subsegments addressed in this report. The numeric water quality criterion that applies to the impaired subsegments and used to calculate the total allowable dissolved oxygen pollutant loads is 5 mg/L.

Table ES-2. Summary of dissolved oxygen TMDLs, WLAs, LAs, MOSs, and FGs

Subsegment	Oxygen demand (lb/d)				
120102	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.00	3,036.82	1,438.96	949.12	5,424.91
MOS for WLA	0.00	379.60	179.87	118.64	678.11
FG for WLA	0.00	379.60	179.87	118.64	678.11
LA	19.73	8.28	0.09	2.21	30.32
MOS for LA	2.47	1.04	0.01	0.28	3.79
FG for LA	2.47	1.04	0.01	0.28	3.79
TMDL	24.66	3,806.38	1,798.82	1,189.16	6,819.03
Subsegment	**Oxygen demand (lb/d)**				
120103	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	46.8	415.2	220.7	120.1	802.8
MOS for WLA	5.9	51.9	27.6	15.0	100.3
FG for WLA	5.9	51.9	27.6	15.0	100.3
LA	1,137.5	3,482.3	1,217.3	845.8	6,682.9
MOS for LA	142.2	435.3	152.2	105.7	835.4
FG for LA	142.2	435.3	152.2	105.7	835.4
TMDL	1,480.4	4,871.9	1,797.4	1,207.4	9,357.1

Table ES-2. (continued)

Subsegment	Oxygen demand (lb/d)				
120105	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.00	36.03	22.61	11.30	69.94
MOS for WLA	0.00	4.50	2.83	1.41	8.74
FG for WLA	0.00	4.50	2.83	1.41	8.74
LA	60.78	11.70	0.19	5.24	77.91
MOS for LA	7.60	1.46	0.02	0.65	9.74
FG for LA	7.60	1.46	0.02	0.65	9.74
TMDL	75.98	59.65	28.49	20.68	184.81
Subsegment	**Oxygen demand (lb/d)**				
120106	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.0	916.8	250.1	287.7	1,454.6
MOS for WLA	0.0	114.6	31.3	36.0	181.8
FG for WLA	0.0	114.6	31.3	36.0	181.8
LA	591.0	1,216.9	0.0	812.9	2,620.8
MOS for LA	73.9	152.1	0.0	101.6	327.6
FG for LA	73.9	152.1	0.0	101.6	327.6
TMDL	738.7	2,667.2	312.6	1,375.7	5,094.2
Subsegment	**Oxygen demand (lb/d)**				
120107	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.00	0.00	0.00	0.00	0.00
MOS for WLA	0.00	0.00	0.00	0.00	0.00
FG for WLA	0.00	0.00	0.00	0.00	0.00
LA	4,107.39	16.39	0.30	55.19	4,179.27
MOS for LA	513.42	2.05	0.04	6.90	522.41
FG for LA	513.42	2.05	0.04	6.90	522.41
TMDL	5,134.24	20.48	0.37	68.99	5,224.09
Subsegment	**Oxygen demand (lb/d)**				
120109	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	83.6	506.6	301.9	193.0	1,085.1
MOS for WLA	10.4	63.3	37.7	24.1	135.6
FG for WLA	10.4	63.3	37.7	24.1	135.6
LA	7,957.8	3,518.2	331.6	4,170.4	15,978.0
MOS for LA	994.7	439.8	41.4	521.3	1,997.3
FG for LA	994.7	439.8	41.4	521.3	1,997.3
TMDL	10,051.7	5,031.0	791.9	5,454.3	21,328.9
Subsegment	**Oxygen demand (lb/d)**				
120110	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.000	0.000	0.000	0.000	0.000
MOS for WLA	0.000	0.000	0.000	0.000	0.000
FG for WLA	0.000	0.000	0.000	0.000	0.000
LA	32.445	3.969	0.056	4.798	41.268
MOS for LA	4.056	0.496	0.007	0.600	5.159
FG for LA	4.056	0.496	0.007	0.600	5.159
TMDL	40.556	4.962	0.070	5.998	51.586

Table ES-3 presents a summary of the reduction percentages for LAs. Reduction percentages from baseline conditions for total oxygen demand ranged from 36 to 86 percent. There were two facilities with reductions in WLAs.

Table ES-3. Summary of reduction percentages for LAs in the upper Terrebonne Basin

Subsegment	Percent reduction				
	SOD	$CBOD_u$	Ammonia	Organic N	Total
120102	89.34	71.86	75.00	72.56	86.40
120103	56.05	49.01	57.03	54.21	52.59
120105	48.83	59.33	0.00	58.08	51.38
120106	0.00	75.60	0.00	0.00	59.00
120107	36.23	0.00	0.00	34.46	36.12
120109	16.09	72.07	36.59	73.72	58.47
120110	85.71	33.79	0.00	33.85	82.83

Table ES-4 presents a summary of the nutrient TMDLs for the subsegments addressed in this report. The state's nutrient criteria are narrative and include the following language (LDEQ 2007):

> The naturally occurring range of nitrogen-phosphorous ratios shall be maintained. This range shall not apply to designated intermittent streams. To establish the appropriate range of ratios and compensate for natural seasonal fluctuations, the administrative authority will use site-specific studies to establish limits for nutrients. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters.

Table ES-4. Summary of TMDLs for nutrients in the upper Terrebonne Basin

Subsegment	∑ WLA (lb/d)	∑ LA (lb/d)	MOS	FG (10%) (lb/d)	Total allowable loading (lb/d)	Percent reduction
Total phosphorus						
120102	0.000	0.146	Implicit	0.016	0.162	0.0
120103	0.000	0.373	Implicit	0.041	0.414	0.0
120105	0.000	0.276	Implicit	0.031	0.307	0.0
120106	0.000	0.017	Implicit	0.002	0.019	0.0
120109	0.000	0.430	Implicit	0.048	0.478	0.0
Total nitrogen						
120102	0.000	0.709	Implicit	0.079	0.788	0.0
120103	0.000	1.809	Implicit	0.201	2.010	0.0
120105	0.000	1.342	Implicit	0.149	1.491	0.0
120106	0.000	0.083	Implicit	0.009	0.092	0.0
120109	0.000	2.086	Implicit	0.232	2.317	0.0

Hurricane Katrina made landfall on Monday, August 29, 2005, as a Category 4 hurricane. The storm brought heavy winds and rain to southeast Louisiana, breaching several levees and flooding up to 80 percent of New Orleans and large areas of coastal Louisiana. Both Hurricanes Katrina and Rita have caused a significant amount of change in sedimentation and water quality in southern Louisiana. Many wastewater treatment facilities were temporarily or permanently damaged. Some wastewater treatment facilities will be rebuilt; others will be relocated.

The proposed TMDLs in this report were developed on the basis of pre- and post-hurricane water quality conditions. Some point sources in this TMDL have been updated with post-hurricane information, where available. Post-hurricane water quality conditions and other factors could delay the implementation of these proposed TMDLs, render some proposed TMDLs obsolete, or require modifications of the TMDLs. Although hurricane effects might be valid for some TMDLs, any deviation from the TMDLs should be justified using site-specific data or information.

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1 INTRODUCTION

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not supporting their designated uses, even if pollutant sources have implemented technology-based controls. A TMDL establishes the maximum allowable load (in mass per unit time) of a pollutant that a waterbody is able to assimilate while still supporting its designated uses. The maximum allowable load is determined on the basis of the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

Monitoring data collected by the Louisiana Department of Environmental Quality (LDEQ) indicate that observed dissolved oxygen levels sometimes do not meet the state's water quality criteria for seven subsegments in the upper Terrebonne Basin. The impaired designated uses for the subsegments are primary and secondary contact recreation, and fish and wildlife propagation. The subsegments are either fully supporting (F) or not supporting (N) the designated uses. Table 1-1 presents information from Louisiana's 2004 section 303(d) list for the seven subsegments. All the subsegments have the suspected cause of *unknown sources*, which indicates that various sources might be present but not enough data are available to identify them.

Table 1-1. Subsegments and impairments addressed in this report

Subsegment	Subsegment name	Subsegment description	Designated use		
			PCR	SCR	FWP
120102	Bayou Poydras	Headwaters to Bayou Choctaw	N	F	N
120103	Bayou Choctaw	Bayou Poydras confluence to Bayou Grosse Tete	F	F	N
120105	Chamberlin Canal	Chamberlin to Bayou Choctaw	N	N	N
120106	Bayou Plaquemine	Plaquemine Lock to ICWW	F	F	N
120107	Upper Grand River and Lower Flat River	Headwaters to ICWW	F	F	F
120109	Intracoastal Waterway	ICWW Morgan City to Port Allen Route: Port Allen Locks to Bayou Sorrel Locks	N	F	N
120110	Bayou Cholpe	Headwaters to Bayou Choctaw	F	F	N

Oxygen concentrations in the water column fluctuate under natural conditions, but severe depletion usually results from human activities that introduce large quantities of biodegradable organic materials into surface waters. In polluted waters, bacterial degradation of organic materials can result in a net decline in oxygen concentrations in the water. Oxygen depletion can also result from chemical reactions that place a chemical oxygen demand on receiving waters. Other factors, such as temperature and salinity, influence the amount of oxygen dissolved in water. For example, prolonged hot weather decreases oxygen concentrations and can cause fish kills even in clean waters because warm water cannot hold as much oxygen as cold water (Scorecard 2005).

Other factors that affect dissolved oxygen concentrations include the following (Murphy 2005):

- Volume and velocity of water flowing in the waterbody
- Climate and season
- The type and number of organisms in the waterbody
- Altitude
- Dissolved or suspended solids
- Amount of nutrients in the water
- Organic waste
- Riparian vegetation
- Ground water inflow

Low dissolved oxygen concentrations in streams can be linked to both natural conditions and human activities. In Louisiana natural stream conditions like low flow, high temperature, and high organic content often result in dissolved oxygen levels already below current water quality criteria, making it difficult to develop standards for best management practices, or BMPs (Mason et al. 2007). Additional data for these 303(d)-listed areas are needed to determine whether the low dissolved oxygen occurs naturally or is related to human activity (i.e., is anthropogenic).

2 BACKGROUND INFORMATION

2.1 General Description

The study region consisted of seven subsegments in the upper portion of the Terrebonne Basin. They include Bayou Cholpe – Headwaters to Bayou Choctaw (subsegment 120110), Bayou Poydras (subsegment 120102), Chamberlin Canal (subsegment 120105), Bayou Choctaw (subsegment 120103), ICWW – Morgan City to Port Allen Route (subsegment 120109), Bayou Plaquemine – Plaquemine Lock to ICWW (subsegment 120106), and Upper Grand River and Lower Flat River – Headwaters to ICWW (subsegment 120107). In Louisiana, the upper Terrebonne Basin includes portions of Point Coupe, Iberville, and West Baton Rouge Parishes. Table 2-1 lists the parish and approximate drainage area of each subsegment and Figure 2-1 shows the locations of the subsegments. The watershed's U.S. Geological Survey (USGS) hydrologic unit code is 08070300.

Table 2-1. Drainage area and parish of each subsegment

Subsegment name	Subsegment	Parish	Area (mi^2)	Area (km^2)
Bayou Poydras	120102	Point Coupee, West Baton Rouge	22	56
Bayou Choctaw	120103	Iberville, West Baton Rouge	55	144
Chamberlin Canal	120105	West Baton Rouge	41	107
Bayou Plaquemine	120106	Iberville	2	6
Upper Grand River and Lower Flat River	120107	Iberville	88	229
Intracoastal Waterway	120109	Iberville, West Baton Rouge	64	166
Bayou Cholpe	120110	Iberville, Point Coupee	25	63

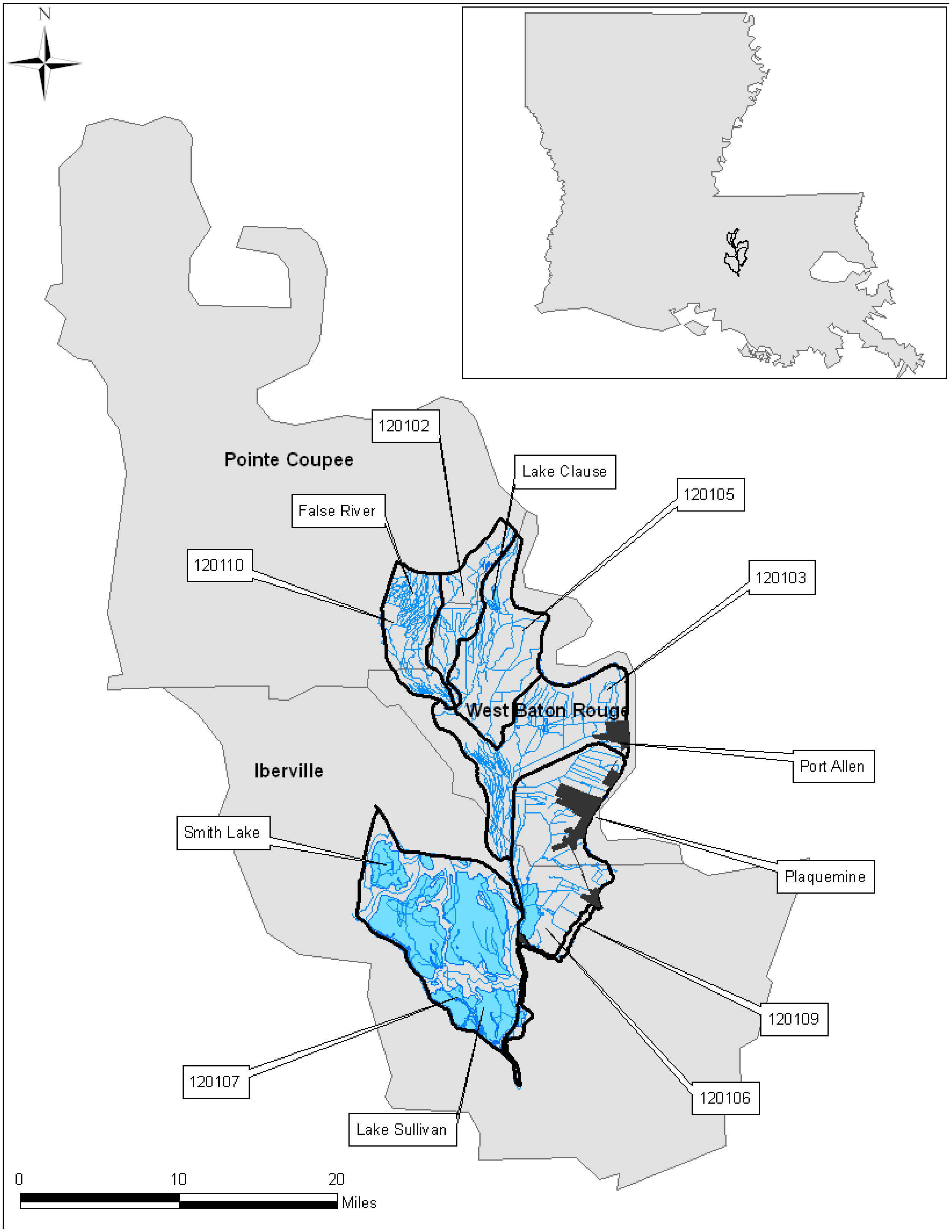

Figure 2-1. Locations of upper Terrebonne Basin subsegments.

2.2 Land Use

Land use data were obtained from the 2001 USGS National Land Cover Dataset (NLCD; Table 2-2 and Figure 2-2). The predominant land use in the impaired subsegments is wetland. The percentage of wetlands in the watersheds ranges from 23.5 percent to 95.4 percent followed by cultivated crops, pasture/hay, and developed. There is very little barren, forest, or grassland/shrub land in any of the seven subsegments. Subsegments 120103, 120109, 120106 have larger areas of developed land. Subsegment 120107 is almost entirely wetland and open water. It has only just less than 1 percent developed area, which consists of highways.

Table 2-2. Land uses percentages for each listed subsegment in the upper Terrebonne Basin

Land use	Percent of total area						
	Bayou Cholpe (120110)	Bayou Poydras (120102)	Chamberlin Canal (120105)	Bayou Choctaw (120103)	Intracoastal Waterway (120109)	Bayou Plaquemine (120106)	Upper Grand River and Lower Flat River (120107)
Water	0.58	0.15	0.04	0.69	2.66	5.56	2.44
Developed	2.04	5.90	3.29	11.33	13.13	22.35	0.72
Barren	0.01	0.00	0.00	0.02	0.02	0.00	0.00
Forest	0.01	0.00	0.01	0.01	0.01	0.01	0.00
Grassland/shrub	0.31	0.53	0.69	0.97	0.54	0.24	0.45
Pasture/hay	8.01	22.57	10.57	7.18	4.37	19.63	0.97
Cultivated crops	35.27	47.33	56.05	29.56	32.58	23.65	0.00
Wetlands	53.76	23.51	29.35	50.24	46.68	28.56	95.42
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00

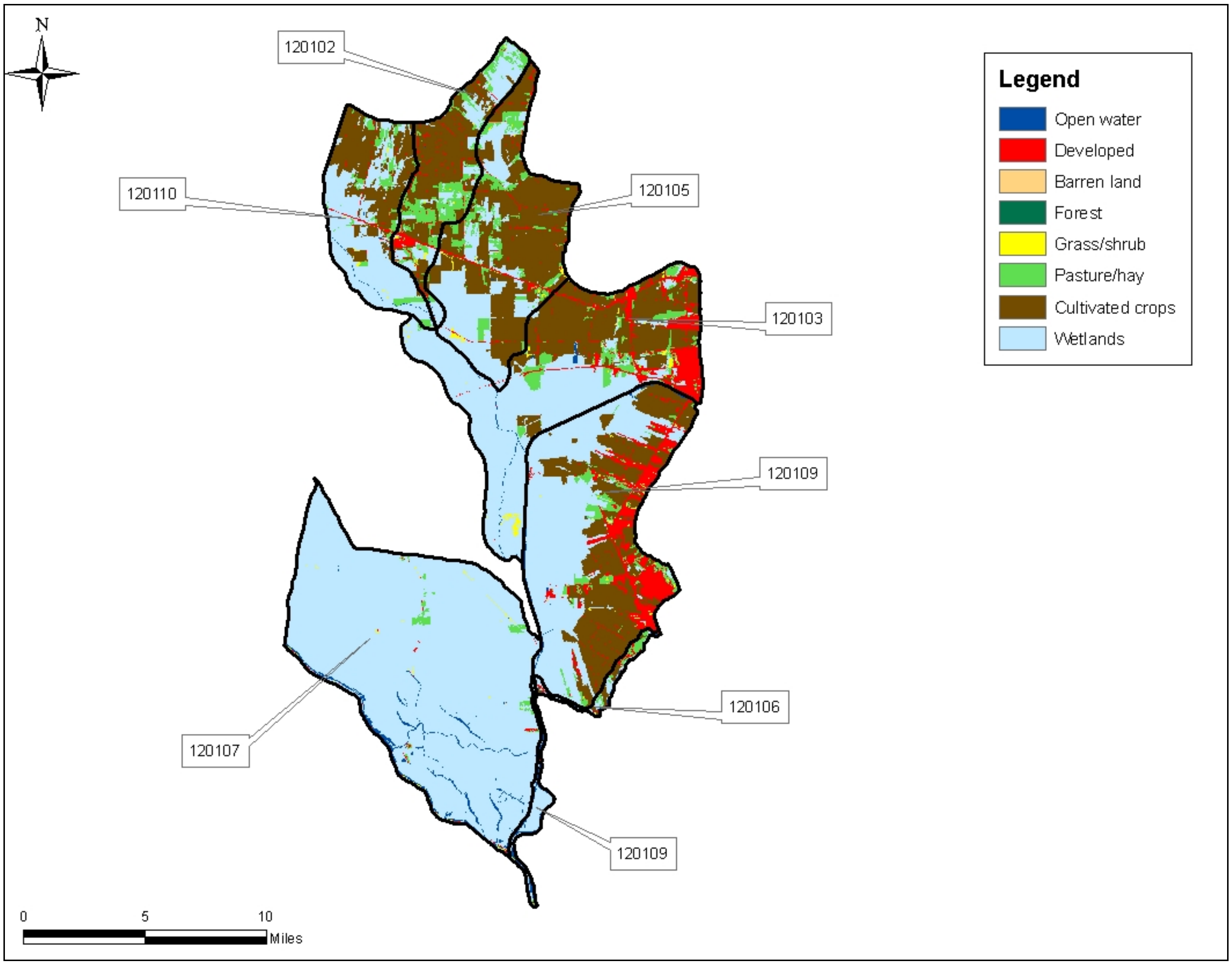

Figure 2-2. Land use in the upper Terrebonne Basin subsegments.

2.3 Hydrologic Setting

The USGS online hydrology database (NWISWeb) does not contain any stations with flow data for the listed subsegments that are impaired for dissolved oxygen and nutrients. Because reversing flows occur at times throughout the Terrebonne Basin, there are very few USGS flow gages in the Terrebonne Basin. The only flow gages in the Terrebonne Basin that have a long period of flows are on streams that are not similar to any of the streams in the subsegments.

2.4 Designated Uses and Water Quality Criteria

Louisiana's 2004 section 303(d) list indicates that the seven listed subsegments—all assigned a use of primary or secondary contact recreation, or fish and wildlife propagation—do not meet applicable water quality standards because of unknown sources. Primary contact recreation includes any recreational or other water contact involving full-body exposure to water and a considerable probability of ingesting water. Examples of this use are swimming and water skiing. Secondary contact recreation involves activities like fishing, wading, or boating, where water contact is accidental or incidental and there is a minimal chance of ingesting appreciable amounts of water. Fish and wildlife propagation includes the use of water for aquatic habitat, food, resting, reproduction, cover, or travel corridors for any indigenous wildlife and aquatic life species associated with the aquatic environment.

The assessment methodology presented in LDEQ's 305(b) report (LDEQ 2004) specifies that primary contact recreation, secondary contact recreation, and fish and wildlife propagation uses are to be fully supported. The state minimum dissolved oxygen criterion for the subsegments in this TMDL is 5 milligrams per liter (mg/L) year-round.

Louisiana does not have numeric water quality standards for nutrients, but its narrative standard for nutrients states the following:

- The naturally occurring range of nitrogen-phosphorus ratios shall be maintained (except for intermittent streams), and
- Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters.

The Louisiana water quality standards also include an antidegradation policy (*Louisiana Administrative Code* [LAC] Title 33, Part IX, Section 1109.A), which states that state waters exhibiting high water quality should be maintained at that high level of water quality. If that is not possible, water quality of a level that supports the designated uses of the waterbody should be maintained. The designated uses of a waterbody may be changed to allow a lower level of water quality only through a use attainability study.

2.5 Identification of Sources

2.5.1 Point Sources

LDEQ stores permit information using internal databases. LDEQ generated a list of point source discharges in the study area by using the TEMPO and PTS databases. Information on point source discharges to the listed subsegments was obtained from the Electronic Document Management System (EDMS) database at LDEQ. Data were pulled from EDMS and analyzed for the TMDLs. Each facility was evaluated on the basis of its discharges and permit limits to determine whether the facility would be used in developing the TMDLs. The evaluation yielded 11 permitted point source discharges in subsegment 120102, 39 in subsegment 120103, 5 in subsegment 120105, 7 in subsegment 120106, and 46 permitted point source discharges in subsegment 120109. Because of the large number of permits, they are listed in Appendix A.

Phase I and II stormwater systems are additional possible point source contributors in the Terrebonne Basin. Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. These discharges often contain high concentrations of pollutants that can eventually enter nearby waterbodies. Most stormwater discharges are considered point sources and require coverage by a National Pollutant Discharge Elimination System (NPDES) permit.

Under the NPDES stormwater program, operators of large, medium, and regulated small municipal separate storm sewer systems (MS4s) must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 *Federal Register* 47990, November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population within the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population between 100,000 and 249,999; a large MS4 has a population of 250,000 or more.

Phase II requires a select subset of small MS4s to obtain an NPDES stormwater permit. A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4. The Phase II rule automatically covers all small MS4s in urbanized areas (UAs), as defined by the Bureau of the Census, and also includes small MS4s outside a UA that are so designated by NPDES permitting authorities, case by case (USEPA 2000).

In Louisiana, there are two ways that an MS4 can be identified as a regulated, small MS4. This category includes all cities within UAs and any small MS4 area outside UAs with a population of at least 10,000 and a population density of at least 1,000 people per square mile (LDEQ 2002). In the Terrebonne Basin, the city of Port Allen is a regulated, small MS4. Table 2-3 presents MS4 information by subsegment for MS4 discharges to impaired subsegments in the Terrebonne Basin.

Table 2-3. MS4 information for the Terrebonne Basin

NPDES permit number	Authority	Discharge subsegment	Subsegment name	Urban area (acres)
LAR0410102	Port Allen	120103	Bayou Choctaw	1,405
LAR0410102	Port Allen	120109	Intracoastal Waterway	426

2.5.2 Nonpoint Sources

Louisiana's section 303(d) list does not identify the suspected cause of the dissolved oxygen impairment in the subsegments of the upper Terrebonne Basin. The source is listed as *unknown*.

3 CHARACTERIZATION OF EXISTING WATER QUALITY

3.1 Water Quality Data

Water quality data were obtained from LDEQ's routine ambient water quality monitoring program (Figure 3-1). Appendix B includes summaries of the data for the 303(d)-listed constituents, along with additional constituents used in the TMDL development process. Dissolved oxygen data were available for each of the four listed subsegments (see Table 3-1).

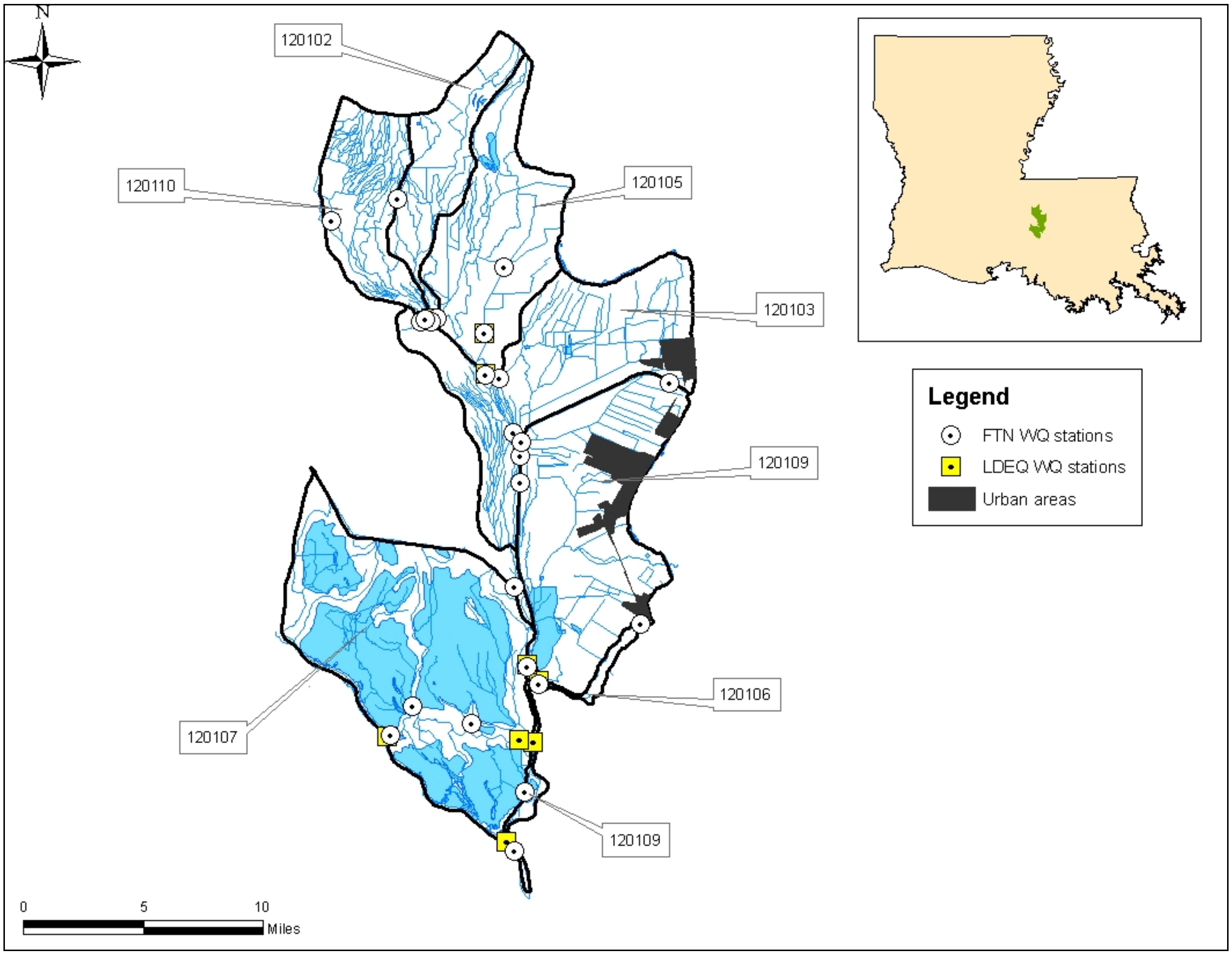

Figure 3-1. Locations of monitoring stations in the upper Terrebonne Basin.

A field survey of the four model subsegments was conducted in the Terrebonne Basin during July 2006. The hydrologic conditions during the field survey were typical for the Terrebonne Basin during summer (high temperatures and generally low flows). A list of the field survey sites and the types of data collected at each site is presented in Table 3-2. The water quality samples were analyzed for 20-day carbonaceous biochemical oxygen demand (CBOD) time series, total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3-N), nitrate+nitrite nitrogen, total phosphorus, chlorophyll *a*, total organic carbon (TOC), and total suspended solids (TSS). The in situ measurements and water quality sampling results are summarized in Appendix B. Appendix B also contains summaries of the depth, widths, and flows measured with the acoustic Doppler current profiler (ADCP) instrument. Plots of the continuous monitoring data are presented in Appendix B. Field notes from the July 2006 field survey are included in Appendix C.

Table 3-1. LDEQ water quality monitoring stations and dissolved oxygen data summaries

Subsegment	Station	Station name	Period of record	No. of obs.	DO min. (mg/L)	DO ave. (mg/L)	DO max. (mg/L)
120103	336	Bayou Poydras	1/15/91–3/9/04	91	0.64	5.63	24.42
120102	969	Bayou Choctaw west of Port Allen, LA	2/1/00–4/13/04	15	2.69	6.40	9.15
120105	971	Chamberlin Canal	2/1/00–4/13/04	15	2.48	5.96	8.78
120106	972	Bayou Plaquemine	2/1/00–4/13/04	15	2.90	6.30	9.53
120107	973	Upper Grand River, LA	2/1/00–4/13/04	15	3.43	6.33	10.00
120109	80	Lower Grand River at Bayou Sorrel, LA	1/1/67–5/11/98	350	0.27	12.20	5.88
120109	417	Bayou Plaquemine, LA	1/1/63–12/1/66	47	1.90	12.00	6.87
120109	975	Intracoastal Waterway near Indian Village	2/1/00–4/13/04	15	5.30	7.35	10.23
120110	976	Bayou Chalpin	2/1/00–4/13/04	15	3.22	6.26	9.23

Note: DO = dissolved oxygen

Table 3-2. Data types from July 2006 monitoring

Subsegment	Site ID	Site name	Data types collected
120102	120102-A	Bayou Poydras north of Erwinville, LA	In situ, sample, flow, cross section
120102	969	Bayou Poydras	In situ, sample, flow, cross section, contin.
120103	120103-A	Tributary to Bayou Choctaw	In situ, sample, flow
120103	120103-B	Bayou Tommy at LA Hwy 76	In situ, sample, flow
120103	120103-C	Bayou Choctaw NW of Intracoastal Waterway	In situ, flow, cross section
120103	336	Bayou Choctaw west of Port Allen, LA	In situ, sample, flow, cross section
120105	120105-A	Chamberlin Canal at US Hwy 190	In situ, sample, flow, cross section
120105	120105-B	Stumpy Bayou at LA Hwy 76	In situ, sample, flow
120105	971	Chamberlin Canal	In situ, sample, flow, cross section
120106	120106-A	Bayou Plaquemine at Plaquemine, LA	In situ, sample, flow, cross section
120106	972	Bayou Plaquemine	In situ, sample, cross section
120107	120107-A	Superior Canal NE of Grand River, LA	In situ, sample, flow
120107	120107-B	Upper Grand River near levee	In situ, sample, flow, cross section
120107	120107-C	Lower Flat River E of Grand River, LA	In situ, sample, flow, cross section
120107	973	Upper Grand River, LA	In situ, sample, flow
120109	120109-A	Intracoastal Waterway at Port Allen, LA	In situ, sample, flow
120109	120109-B	Intracoastal Waterway W of Brusly, LA	In situ, sample, cross section
120109	120109-C	Intracoastal Waterway upstream of Bayou Choctaw	In situ, cross section
120109	120109-D	Intracoastal Waterway W of Brusly, LA	In situ, cross section
120109	120109-E	Bayou Grosse Tete NW of Intracoastal Waterway	In situ, sample, flow
120109	975	Intracoastal Waterway near Indian Village	In situ, flow, cross section, contin.
120109	120109-F	Intracoastal Waterway south of The Parks, LA	In situ, sample, flow, cross section
120109	80	Lower Grand River at Bayou Sorrel, LA	In situ, sample
120110	120110-A	Bayou Cholpe west of Erwinville	In situ, sample, flow, cross section
120110	976	Bayou Chalpin	In situ, sample, flow, cross section

3.2 Comparison of Observed Data to Criteria

Water quality monitoring data were obtained from LDEQ and during the July 2006 sampling event. Table 3-3 provides a summary of the LDEQ dissolved oxygen data available for stations in the model subsegments. Each station has between 15 and 350 data points. Eight of the nine stations had dissolved oxygen observations below the water quality criterion of 5 mg/L.

Table 3-3. Summary of dissolved oxygen data for the upper Terrebonne Basin

LDEQ station	Subsegment	Period of record	No. of samples	DO min. (mg/L)	DO ave. (mg/L)	DO max. (mg/L)	Percent < 5 mg/L
336	120103	1/15/91–3/9/04	91	0.64	5.63	24.42	40.7
969	120102	2/1/00–4/13/04	15	2.69	6.40	9.15	26.7
971	120105	2/1/00–4/13/04	15	2.48	5.96	8.78	33.3
972	120106	2/1/00–4/13/04	15	2.90	6.30	9.53	26.7
973	120107	2/1/00–4/13/04	15	3.43	6.33	10.00	33.3
80	120109	1/1/67–5/11/98	350	0.27	12.20	5.88	34.0
417	120109	1/1/63–12/1/66	47	1.90	12.00	6.87	13.0
975	120109	2/1/00–4/13/04	15	5.30	7.35	10.23	0.0
976	120110	2/1/00–4/13/04	15	3.22	6.26	9.23	26.7

Table 3-4 provides a summary of the July 2006 dissolved oxygen data for stations in the model subsegments. Each station has between 2 and 18 data points. All four stations had dissolved oxygen observations below the water quality criterion of 5 mg/L, except for subsegment 120406.

Table 3-4. Summary of dissolved oxygen data from July 2006 monitoring event

Subsegment	# of locations	Range of sample depths	# of samples	DO min. (mg/L)	DO max. (mg/L)	DO ave. (mg/L)	Percent samples < 5 mg/L
120102	2	1–1.2	2	0.3	3.6	2.0	100
120103	4	0.5–12	7	1.8	13.0	4.9	71
120105	3	0.3–2.5	3	2.0	3.8	2.9	100
120106	2	2.5–9	5	2.0	13.0	7.8	40
120107	4	2.5–5	5	3.1	5.5	3.9	80
120109	8	1.5–19	33	1.5	6.2	4.7	52
120110	2	0.9–3	2	4.0	4.5	4.2	100

4 LOW DISSOLVED OXYGEN MODEL SETUP AND CALIBRATION

4.1 Model Setup

LA-QUAL (Version 8.11) was chosen to simulate dissolved oxygen in the TMDL subsegments. LA-QUAL is a steady-state model that LDEQ developed based on the QUAL-TX (Version 3.4) model. Several modifications were made to the QUAL-TX model, including the addition of new aeration equations that better represent conditions in Louisiana.

LA-QUAL evaluates the relationships between pollutant sources and water quality. Model configuration involved setting up the model segments and setting initial conditions, boundary conditions, and hydraulic and kinetic parameters. This section describes the configuration and key components of the model.

Only the main stems of the systems were explicitly simulated and thus segmented for modeling purposes. Segmentation refers to separating a waterbody into smaller computational units. Segmentation occurred around major hydrological features, such as tributaries. Tributaries were represented through boundary condition designation. Appendix D contains diagrams of the model segmentations and stream kilometers.

4.2 Calibration Period

The calibration period was selected to coincide with the intensive field monitoring that had occurred in July 2006. The data used for calibration are the averages of the samples taken during the measurement period from July 10 through July 13, 2006. These dates were selected for calibration because they were the only dates for which data were available. This period is considered the critical period because high temperatures decrease dissolved oxygen saturation values and increase rates for oxygen-demanding processes, such as biochemical oxygen demand (BOD) decay, nitrification, and sediment oxygen demand (SOD). In addition, lower flow rates do not cause strong reaeration, so the exchange of oxygen between air and water is low.

4.3 Model Options (Data Type 2)

Data type 2 is used to identify the constituents being modeled to achieve calibration—for this TMDL, dissolved oxygen, BOD, and a nitrogen series (ammonia nitrogen, and nitrate+nitrite).

4.4 Program Constants (Data Type 3)

LA-QUAL is programmed with certain default program parameters. Data type 3 is used to override the default parameters and is optional; that is, values need to be entered only if values other than the default values are desired. Default values were used for all program parameters except for the hydraulic calculation method. This parameter was changed from method 1 to method 2. For descriptions of the parameters and their default values, see the LA-QUAL user manual (Wiland Consulting, Inc. 2005).

4.5 Temperature Correction of Kinetics (Data Type 4)

Data type 4 contains factors used for temperature correction in rate equations. The temperature correction factors used in the model were consistent with the *Standard Operating*

Procedure for Louisiana TMDL Technical Procedures (LTP) when these factors were available (LDEQ 2005). The correction factors were as follows:

- Correction for BOD decay: 1.047 (LTP and model default)
- Correction for SOD: 1.065 (LTP and model default)
- Correction for ammonia N decay: 1.083 (model default)
- Correction for organic N decay: 1.020 (model default)
- Correction for reaeration: 1.024 (LTP and model default)

4.6 Hydraulics and Dispersion (Data Types 9 and 10)

These data types describe the hydraulic and dispersion characteristics of the model reaches. The stream hydraulics were specified in the input file for the model using the following power functions:

$$width = a \times Q^b + c$$
$$depth = d \times Q^e + f$$

where:

a =	width coefficient	=	0.0
b =	width exponent	=	0.0
c =	width constant	=	average width of segment
d =	depth coefficient	=	0.0
e =	depth exponent	=	0.0
f =	depth constant	=	average depth of segment

The average width and depth for each segment were based on observed measurements in July 2006; they are shown in Table 4-1. Slight adjustments in some reaches to better simulate observed hydrology and water quality.

Table 4-1. Average channel widths and depths for each model segment

Model reach	Width (m)	Depth (m)
1	1	0.25
2	10	1
3	4	0.3
4	8	0.6
5	34	2.4
6	2	0.1
7	5	0.3
8	47	2.8
9	76	3
10	76	3
11	30	1.1
12	80	3.2
13	88	1.1
14	64	0.8
15	62	1.3
16	70	2.5

4.7 Initial Conditions (Data Type 11)

Initial conditions were set for temperature, dissolved oxygen, nitrate+nitrite, and chlorophyll *a* using observed water quality data, while ammonia data were set to a constant. Because LA-

QUAL is a steady-state model, the initial conditions affect only the number of iterations needed to reach steady-state conditions. Setting initial conditions on the basis of observed data reduces the amount of iterations the model must perform to reach steady-state.

Salinity, nitrate+nitrite, phosphorus, phytoplankton, and macrophytes were the parameters not simulated in the model. Their initial conditions were set to zero so that the model would not assume a fixed concentration and include their effects.

4.8 Water Quality Kinetics (Data Types 12 and 13)

Several kinetic rates, including reaeration, SOD, CBOD decay, nitrification, and mineralization (organic nitrogen decay) rates, were used in the model. Data types 12 and 13 focus on different rates used by the model. Data type 12 is needed only if BOD or dissolved oxygen is being simulated, and data type 13 is needed only if nitrogen or phosphorus is being simulated. For this TMDL, both data types were included.

The model calculates the reaeration rate by using one of a standard set of equations. For this TMDL, the O'Conner-Dobbins equation was used. This equation is applicable to moderately deep to deep channels (1 ft to 30 ft with flow between 0.5 ft/s and 12.2 ft/d). The equation is

$$K_2 = \frac{3.932 \times V^{0.969}}{D^{1.5}}$$

where:

V = stream velocity (meters per second)
D = stream depth (meters)

The input files that list these values are provided in Appendix E. Table 4-2 summarizes these rates. The CBOD decay rate varied per subsegment and was based on the measured $CBOD_3$, $CBOD_5$, $CBOD_{12}$, $CBOD_{20}$, and $CBOD_{25}$ data. Slight adjustments were made in some reaches to better simulate observed water quality. The SOD was calibrated in the model and varied per subsegment reach. SOD was calibrated after the CBOD levels were finalized. The SOD rates changed iteratively until modeled dissolved oxygen concentrations agreed well with measured water column dissolved oxygen concentrations.

Table 4-2. Water quality kinetics rates

Program constant	Value range
Background SOD (g/m^2/d)	0.5–3.0
BOD #1 decay rate (aerobic) (1/d)	0.1–0.3
Ammonia decay rate (1/d)	0.01–0.02
Ammonia nitrogen oxidation rate (1/d)	0.2

4.9 Incremental Data (Data Types 16, 17, and 18)

These data types include information on inflows and outflows from the model reaches. For this TMDL, incremental information for flow, temperature, dissolved oxygen, $CBOD_u$, organic nitrogen, ammonia, and nitrate+nitrite was included. Appendix E contains the input files with these values. Incremental flow was determined from flow measurements obtained during the July 2006 monitoring.

4.10 Nonpoint Source Loads (Data Type 19)

This data type accounts for nonpoint source loads not associated with incremental and tributary flows. The nonpoint source loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, $CBOD_u$ loads, and organic nitrogen loads. The SOD (from data type 12) and the mass loads of organic nitrogen and $CBOD_u$ (data type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values.

Typically, these three calibration parameters were adjusted in a specific order based on the interactions between state variables in the model. First, the organic nitrogen loads were adjusted until the predicted organic nitrogen concentrations were similar to the observed concentrations. Organic nitrogen was calibrated first because none of the other state variables will affect the organic nitrogen concentrations. Next, the $CBOD_u$ loads were adjusted until the predicted $CBOD_u$ concentrations were similar to the observed concentrations. Finally, the SOD rates were adjusted until the predicted dissolved oxygen concentrations were similar to the observed concentrations. The SOD rate was not adjusted below 0.5 grams per square meter per day (g/m^2/day). The dissolved oxygen was calibrated last because all the other state variables affect dissolved oxygen.

4.11 Headwater Flow, Water Quality, and Junction Data (Data Types 20, 21, 22, and 23)

These data types account for flow and water quality from upstream of the modeled subsegment. Headwater flow and water quality data were derived from monitoring data. In general, the flow measured at the most upstream station was taken as the headwater flow. Water quality data (mainly $CBOD_u$ and dissolved oxygen) were estimated from the monitoring data at the most upstream stations.

4.12 Wasteload Flow and Water Quality Data (Data Types 24, 25, and 26)

These data types account for flow and water quality from point sources discharging into the listed waterbodies. The model included 20 permitted outflows, plus 81 permitted sources that were combined because of lack of discharge pathway information. There were also 7 tributaries that were included as input in these data types. The inputs and their associated flows and concentrations are provided in Table 4-3. Data from tributaries was developed from observed data. Permit design flows were used as the flows from permits. Dissolved oxygen was set to 5.0 for point sources. Permitted BOD_5 discharge limits were converted to ultimate CBOD using a conversion factor of 2.3. Organic nitrogen and nitrate+nitrite were assumed from surrounding waters. Ammonia was assumed to be 1.5 mg/L for smaller point sources. For larger point sources, ammonia was taken from permit limits or from discharge monitoring reports. When point sources were combined, flow-weighted averages were used.

Table 4-3. Summary of point sources and tributaries used in LA-QUAL

Point source/ tributary name	Flow (mgd)	DO (mg/L)	$CBOD_u$ (mg/L)	Org N (mg/L)	Ammonia (mg/L)	NO_3+NO_2 (mg/L)	Comment
Bayou Grosse Tete #2	31.0187	2.0	3.5	1.1	0.03	0.0	Tributary
LA0003034	0.0000	5.0	23.0	1.5	1.50	2.0	Point source in 120102

Table 4-3. (continued)

Point source/ tributary name	Flow (mgd)	DO (mg/L)	$CBOD_u$ (mg/L)	Org N (mg/L)	Ammonia (mg/L)	NO3+NO2 (mg/L)	Comment
LA0020648	1.5000	5.0	69.0	1.6	4.00	1.6	Point source in 120106
LA0068501	0.3000	5.0	23.0	1.1	4.00	10.0	Point source in 120109
LA0121185	0.0000	5.0	103.5	1.2	1.50	2.0	Point source in 120105
LAG530786	0.0050	5.0	103.5	1.2	1.50	2.0	Point source in 120105
LAG531065	0.0050	5.0	103.5	1.6	1.50	1.6	Point source in 120106
LAG531362	0.0010	5.0	103.5	1.1	1.50	1.7	Point source in 120109
LAG531616	0.0003	5.0	103.5	1.1	1.50	10.0	Point source in 120109
LAG531697	0.0007	5.0	103.5	1.5	1.50	2.0	Point source in 120102
LAG531903	0.0001	5.0	103.5	1.5	1.50	2.0	Point source in 120102
LAG531990	0.0016	5.0	103.5	1.5	1.50	2.0	Point source in 120102
LAG540069	0.0030	5.0	103.5	1.5	1.50	2.0	Point source in 120102
LAG540102	0.0240	5.0	69.0	1.6	1.50	1.6	Point source in 120106
LAG540783	0.0490	5.0	69.0	2.0	1.50	0.5	Point source in 120105
LAG540784	0.0026	5.0	69.0	1.6	1.50	1.6	Point source in 120106
LAG540785	0.0120	5.0	69.0	1.5	1.50	2.0	Point source in 120102
LAG540858	0.0064	5.0	69.0	1.5	1.50	2.0	Point source in 120102
LAG540898	0.0400	5.0	69.0	1.5	1.50	2.0	Point source in 120102
LAG560237	0.0070	5.0	46.0	1.1	1.50	1.7	Point source in 120109
LAG570359	0.0650	5.0	23.0	1.6	1.50	1.6	Point source in 120106
PS 120103	0.4296	3.1	63.7	1.5	1.50	0.1	Combined point sources
PS 120109#1	0.4419	5.0	34.0	1.1	3.50	10.0	Combined point sources
PS 120109#2	0.0239	5.0	71.1	1.1	1.50	10.0	Combined point sources
PS 120109#3	0.1038	5.0	35.0	1.1	1.50	10.0	Combined point sources
Stumpy Bayou	8.6594	3.6	9.9	1.0	0.10	1.0	Tributary
Superior Canal	22.1008	5.5	10.0	1.4	0.10	0.0	Tributary
Unknown Trib #1	5.3636	3.1	4.3	1.5	1.50	0.1	Tributary
Unknown Trib #2	0.0023	6.3	3.0	1.2	0.10	1.5	Tributary
Unknown Trib #3	0.0023	6.3	3.0	1.2	0.10	1.5	Tributary
Unknown Trib #4	0.0023	6.3	3.0	1.2	0.10	1.5	Tributary

4.13 Calibration and Model Results

Model calibration was a multistep process using ammonia, $CBOD_u$, and SOD concentrations for each reach, starting with the most upstream reach and working down to the outflow reach. Organic nitrogen was first adjusted so that predicted concentrations matched observed data. The ammonia and nitrate loads were then adjusted so that the predicted nitrogen concentrations would match the observed concentrations. After ammonia was calibrated, the $CBOD_u$ loads were adjusted until the predicted $CBOD_u$ concentrations were similar to the observed concentrations. Finally, SOD was adjusted until the predicted dissolved oxygen concentrations were similar to the observed concentrations.

Table 4-4 lists the oxygen demand loadings for calibration conditions, which were based on existing conditions. Overall, the model did well in predicting the observed values for temperature, ammonia, $CBOD_u$, and dissolved oxygen, and was considered adequately calibrated on the basis of the data available. Plots of observed and calibration water quality are presented in Appendix F. Figure 4-1 is an example calibration plot.

Table 4-4. Calibration (existing) oxygen demand

Subsegment	Oxygen demand (lb/d)				
	SOD	$CBOD_u$	Ammonia	Organic N	Total
120102	199.2	9,266.9	15.7	524.8	10,006.6
120103	3,334.6	17,169.8	460.3	4,630.1	25,594.8
120105	145.1	100.4	4.5	19.9	269.8
120106	702.4	7,380.7	278.1	1,132.1	9,493.3
120107	8,528.3	18,355.1	226.1	8,037.7	35,147.2
120109	11,801.3	25,959.0	1,128.0	29,577.3	68,465.6
120110	265.6	1,120.7	2.3	911.1	2,299.7

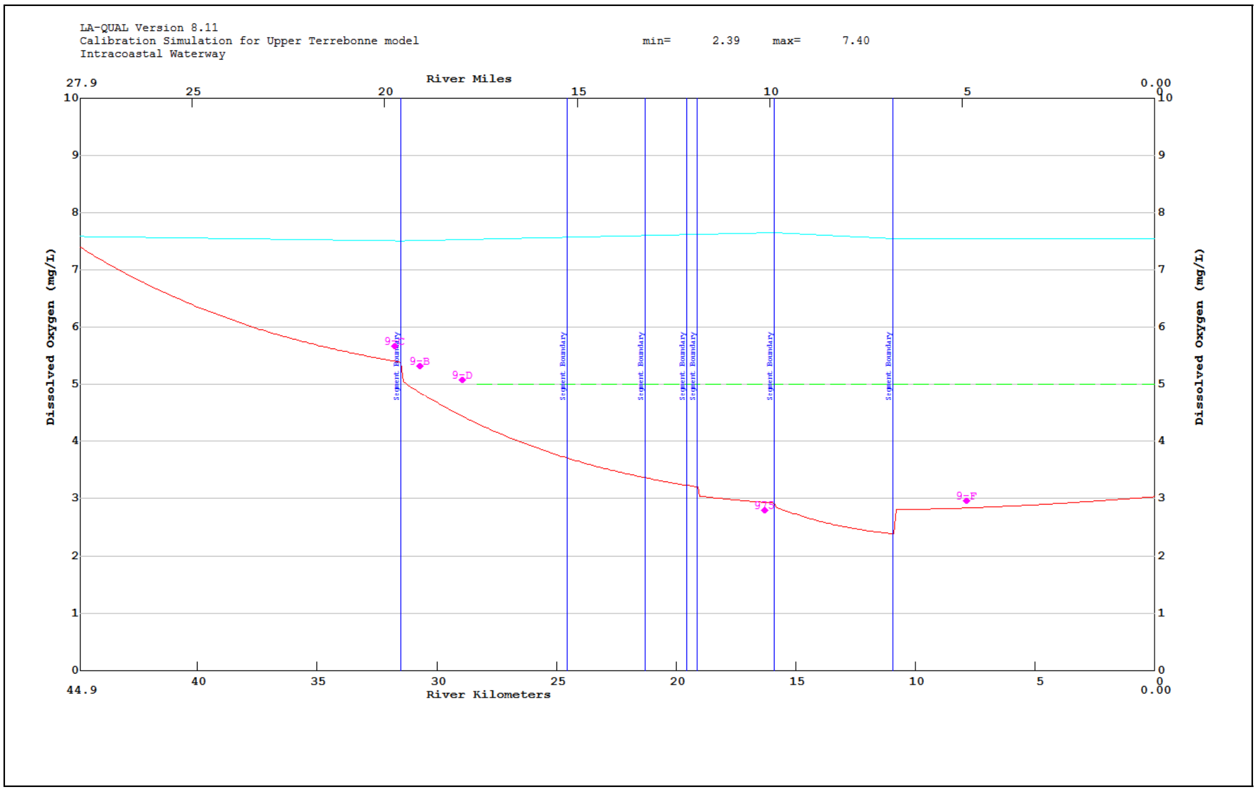

Figure 4.1. Calibration plot for dissolved oxygen in subsegment 120109.

5 LOW DISSOLVED OXYGEN MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require that parties determining TMDLs take into account critical conditions for stream flow, loading, and water quality parameters. The calibrated model was used to project water quality for critical conditions. Two scenarios were run for the critical conditions: baseline and TMDL. The model was run for baseline conditions, which used the same water quality and model parameters as the calibration model; however, the flow and temperature were changed to critical conditions and effluent water quality from permitted dischargers were changed to permit limits. The TMDL model run was the same as the baseline run; however, pollutant loadings were reduced so that dissolved oxygen met criteria at all locations. Identifying critical conditions and the model input data used for critical conditions are discussed in this section. Appendix F contains the baseline output file and Appendix G contains the TMDL output file. The output files include the input parameters.

5.1 Identification of Critical Conditions

The LDEQ LTP defines critical conditions in terms of flow and temperature. Critical flow conditions are simulated by using the annual 7Q10 flow or 0.1 cubic feet per second (cfs), whichever is greater. In addition, all point sources are assumed to be discharging at design capacity and at their permit limits. The LTP specifies that the critical temperature should be determined by calculating the 90th percentile seasonal temperature for the waterbody being modeled, if data are available. Otherwise, 30 degrees Celsius (ºC) was used.

5.2 Temperature Inputs

The critical temperatures for the headwaters were based on the 90th percentile temperature of LDEQ ambient monitoring in the representative subsegment. A critical temperature of 30 °C was used for incremental and wasteload inputs. Because these subsegments have a year-round standard for dissolved oxygen, a winter projection simulation was not performed. The most critical time of year for meeting a constant dissolved oxygen standard is the period of high temperatures and low flows.

5.3 Headwater and Tributary (Wasteload) Inputs

The inputs for the headwater and tributaries for the projection simulation were based on guidance in the LTP. According to the LTP, the critical flow rates for summer should be set to either the 7Q10 flow or 0.1 cfs, whichever is greater. Because 7Q10 values for the waterbodies are not available, the headwater and tributary flows used in calibrating the model were set to 0.1 cfs, with the exception of Bayou Plaquemine and the Intracoastal Waterway. It was assumed that during critical times, there might not be headwater flow for 7 days, making the 7Q10 equal to 0 cfs, so 0.1 cfs would be used. The inputs from Bayou Plaquemine and Intracoastal Waterway are actually pumped discharges from the Mississippi River and were kept the same as calibration in the assumption lock usage and water release from the Mississippi River would not change under critical conditions.

Dissolved oxygen from headwaters and tributaries were set to the water quality criterion of 5 mg/L or the observed concentration, whichever was greater. CBOD levels from headwaters and tributaries were reduced until modeled dissolved oxygen met the criteria. The ammonia levels were low from both the headwaters and tributaries; therefore, the ammonia inputs were not changed from the calibration values.

5.4 Point Source Inputs

Input point sources were kept at the same flow as the calibration inputs. Ammonia and organic nitrogen levels were changed from observed or assumed concentrations to proposed concentrations. The nitrogen concentrations were assumed to be half the amount of the oxygen demand, with two-thirds assumed to be ammonia loading and one-third as organic nitrogen loading. These assumptions are consistent with information presented in the LTP. If necessary, input concentrations were reduced to keep the dissolved oxygen concentration above 5 mg/L.

5.5 Baseline Model Results

Baseline line conditions were run under critical temperature and water flow conditions for calibrated parameters and water quality values. Plots of baseline water quality are presented in Appendix I. Table 5-1 presents the baseline oxygen demand for each subsegment.

Table 5-1. Baseline oxygen demand

Subsegment	Oxygen demand (lb/d)				
	SOD	$CBOD_u$	Ammonia	Organic N	Total
120102	231.42	7,551.75	4,716.37	2,368.01	14,867.54
120103	3,234.97	8,875.72	3,754.22	2,415.77	18,280.68
120105	148.49	104.50	43.25	37.13	333.36
120106	738.70	7,380.66	312.65	1,375.71	9,807.72
120107	8,051.63	20.48	0.37	105.26	8,177.75
120109	11,854.72	16,334.81	1,026.66	20,020.74	49,236.93
120110	283.89	7.49	0.07	9.07	300.52

5.6 TMDL Reduction Model Results

Several steps were used to develop the reduction percentages for oxygen demand. The TMDL was calculated by first iteratively reducing SOD. After meeting the dissolved oxygen criterion by reducing SOD, the CBOD reduction rate was calculated by the SOD/CBOD relationship ($SOD = a \times \sqrt{CBOD}$). Slight adjustments were made to the SOD reduction rate, and an updated CBOD reduction rate was calculated. This process was repeated until the optimal reduction rates were determined.

To meet the dissolved oxygen standard, 5.0 mg/L, total oxygen demand must be reduced between 36 to 86 percent. This percentage reduction for nonpoint source loads represents a percentage of the entire nonpoint source loading, not a percentage of the man-made nonpoint source loading from baseline conditions. The nonpoint source loads in this report were not divided between natural and man-made because it would be difficult to estimate natural nonpoint source loads. Plots of TMDL water quality are presented in Appendix J.

6 TMDL DEVELOPMENT

A TMDL is the total amount of a pollutant that a receiving waterbody can assimilate while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls.

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody, and it may include a future growth (FG) component. The TMDL components are illustrated using the following equation:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS + FG$$

The LA is the portion of the TMDL assigned to nonpoint sources such as natural background loadings. For this TMDL, the LA was calculated by subtracting the WLA, MOS, and FG from the total TMDL allocation. LAs were not allocated to separate nonpoint sources because of the lack of available source characterization data.

The WLA portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. The permitted or average (expected or observed) flows were used to calculate the WLAs. If the permitted or average flow was unavailable, the permit maximum flow was used. The permit maximum flow was usually the maximum flow covered by the specific type of general permit. For example, the LPDES Class II Sanitary General Permit covers facilities with flow of up to 25,000 gallons per day. Sometimes the permit maximum flow was significantly greater than the expected flow, and therefore the permit maximum was used only when other flows were not available.

EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from MS4s. For each MS4 in the basin, a gross MS4 load was computed by multiplying the LA by the ratio of the MS4 area in each subsegment to the subsegment area. Note that these values are estimates that can be refined in the future as more information about the MS4s and land-use-specific loadings becomes available. Note also that the MS4 loads presented reflect only that portion of the MS4 in the subsegment. The computed MS4 load was subtracted from the LA and included as a WLA component of the TMDL because MS4s are permitted dischargers but function similarly to nonpoint sources (through storm-driven processes). EPA expects that the MS4 WLAs will be achieved through BMPs and adaptive management.

Section 303(d) of the Clean Water Act and the regulations at 40 CFR 130.7 require that TMDLs include an MOS to account for uncertainty in available data or in the actual effect that controls will have on the loading reductions and receiving water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly using conservative assumptions in establishing the TMDL. In addition to the MOS, an FG component may be added to account specifically for FG in the TMDL area.

There are two ways to incorporate the MOS (USEPA 1991). One way is to implicitly incorporate it by using conservative model assumptions to develop allocations, including the following:

- *Using slightly higher water temperatures than the suggested water temperature.* If dissolved oxygen meets the criterion with higher water temperature, it will meet the criterion with lower water temperature when other factors remain unchanged.
- *Using the dissolved oxygen water quality criteria for model inflows.* Dissolved oxygen from headwaters and tributaries was set to the water quality criterion, which is lower than the 90 percent saturation level of dissolved oxygen at 30 ºC.

The other way is to explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this analysis, the MOS is explicit: 10 percent of each targeted TMDL was reserved as the MOS to account for any uncertainty in the TMDL. Using 10 percent of the TMDL load provides an additional level of protection to the designated uses of the subsegments of concern.

The MOS is an allocation for scientific uncertainly, while the FG is an allocation for growth. Ten percent of the load was allocated for FG in the area covered by the TMDL. This growth includes future urban development, including point sources, MS4 areas, agriculture, and other nonpoint sources. The FG could also be used for sources not accounted for or unknown and therefore not otherwise included in the TMDL.

6.1 Dissolved Oxygen TMDLs

The dissolved oxygen TMDLs are presented as oxygen demand from $CBOD_u$, ammonia nitrogen, and SOD, and they were derived using the LA-QUAL model. A summary of the TMDLs is presented in Table 6-1. The TMDLs were calculated from SOD, $CBOD_u$, ammonia, and organic nitrogen from nonpoint source model inputs, tributary flows, incremental flows, and background. Table 6-2 presents a summary of the reduction percentages for LAs; two reductions were necessary for WLAs. The reduction percentages for total oxygen demand ranged from 36 to 86 percent.

WLAs were calculated using monthly average permit limits, when applicable. If a permit does not have a monthly average permit limit, the weekly average permit limit was used. If the facility has neither a monthly nor a weekly limit, the daily maximum limit was used to calculate loads. All facilities had oxygen demand and limits; however, only a few had ammonia limits. The nitrogen loading was assumed to be half the amount of the oxygen demand, with two-thirds was assumed to be ammonia loading and one-third as organic nitrogen loading. These assumptions are consistent with information presented in the LTP. The WLAs are presented in Tables 6-3 through 6-17. Table 6-18 lists the individual WLAs for the MS4s identified in Section 2.5.

Two facilities required changes to their WLAs. The discharge of the Alma Plantation (LA0003034—subsegment 120102) had oxygen demand and ammonia reduced from a monthly average of 10 mg/L to 5 mg/L and 3.33 mg/L to 1.25 mg/L, respectively; while the discharge of dissolved oxygen was increased from a monthly average of 4.0 mg/L to 6.0 mg/L. In addition, the Ashland Plantation (LAG540783—subsegment 120105) discharge had oxygen demand reduced from a monthly average of 30 mg/L to 10 mg/L, while the discharge of dissolved oxygen was increased from 5.0 mg/L to 6.0 mg/L. The WLAs for these facilities are shown in Tables 6-3 through 6-17. Reductions from other point source discharges are not required as a result of this TMDL.

Table 6-1. Summary of dissolved oxygen TMDLs, WLAs, LAs, MOSs, and FGs

Subsegment	Oxygen demand (lb/d)				
120102	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.00	3,036.82	1,438.96	949.12	5,424.91
MOS for WLA	0.00	379.60	179.87	118.64	678.11
FG for WLA	0.00	379.60	179.87	118.64	678.11
LA	19.73	8.28	0.09	2.21	30.32
MOS for LA	2.47	1.04	0.01	0.28	3.79
FG for LA	2.47	1.04	0.01	0.28	3.79
TMDL	24.66	3,806.38	1,798.82	1,189.16	6,819.03
Subsegment	**Oxygen demand (lb/d)**				
120103	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	46.8	415.2	220.7	120.1	802.8
MOS for WLA	5.9	51.9	27.6	15.0	100.3
FG for WLA	5.9	51.9	27.6	15.0	100.3
LA	1,137.5	3,482.3	1,217.3	845.8	6,682.9
MOS for LA	142.2	435.3	152.2	105.7	835.4
FG for LA	142.2	435.3	152.2	105.7	835.4
TMDL	1,480.4	4,871.9	1,797.4	1,207.4	9,357.1
Subsegment	**Oxygen demand (lb/d)**				
120105	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.00	36.03	22.61	11.30	69.94
MOS for WLA	0.00	4.50	2.83	1.41	8.74
FG for WLA	0.00	4.50	2.83	1.41	8.74
LA	60.78	11.70	0.19	5.24	77.91
MOS for LA	7.60	1.46	0.02	0.65	9.74
FG for LA	7.60	1.46	0.02	0.65	9.74
TMDL	75.98	59.65	28.49	20.68	184.81
Subsegment	**Oxygen demand (lb/d)**				
120106	**SOD**	**$CBOD_u$**	**Ammonia**	**Organic N**	**Total**
WLA	0.0	916.8	250.1	287.7	1,454.6
MOS for WLA	0.0	114.6	31.3	36.0	181.8
FG for WLA	0.0	114.6	31.3	36.0	181.8
LA	591.0	1,216.9	0.0	812.9	2,620.8
MOS for LA	73.9	152.1	0.0	101.6	327.6
FG for LA	73.9	152.1	0.0	101.6	327.6
TMDL	738.7	2,667.2	312.6	1,375.7	5,094.2

Table 6-1. (continued)

Subsegment	Oxygen demand (lb/d)				
120107	SOD	$CBOD_u$	Ammonia	Organic N	Total
WLA	0.00	0.00	0.00	0.00	0.00
MOS for WLA	0.00	0.00	0.00	0.00	0.00
FG for WLA	0.00	0.00	0.00	0.00	0.00
LA	4,107.39	16.39	0.30	55.19	4,179.27
MOS for LA	513.42	2.05	0.04	6.90	522.41
FG for LA	513.42	2.05	0.04	6.90	522.41
TMDL	5,134.24	20.48	0.37	68.99	5,224.09
Subsegment	Oxygen demand (lb/d)				
120109	SOD	$CBOD_u$	Ammonia	Organic N	Total
WLA	83.6	506.6	301.9	193.0	1,085.1
MOS for WLA	10.4	63.3	37.7	24.1	135.6
FG for WLA	10.4	63.3	37.7	24.1	135.6
LA	7,957.8	3,518.2	331.6	4,170.4	15,978.0
MOS for LA	994.7	439.8	41.4	521.3	1,997.3
FG for LA	994.7	439.8	41.4	521.3	1,997.3
TMDL	10,051.7	5,031.0	791.9	5,454.3	21,328.9
Subsegment	Oxygen demand (lb/d)				
120110	SOD	$CBOD_u$	Ammonia	Organic N	Total
WLA	0.000	0.000	0.000	0.000	0.000
MOS for WLA	0.000	0.000	0.000	0.000	0.000
FG for WLA	0.000	0.000	0.000	0.000	0.000
LA	32.445	3.969	0.056	4.798	41.268
MOS for LA	4.056	0.496	0.007	0.600	5.159
FG for LA	4.056	0.496	0.007	0.600	5.159
TMDL	40.556	4.962	0.070	5.998	51.586

Table 6-2. Summary of percent reductions for LAs in the upper Terrebonne Basin

Subsegment	Percent reduction				
	SOD	$CBOD_u$	Ammonia	Organic N	Total
120102	89.34	71.86	75.00	72.56	86.40
120103	56.05	49.01	57.03	54.21	52.59
120105	48.83	59.33	0.00	58.08	51.38
120106	0.00	75.60	0.00	0.00	59.00
120107	36.23	0.00	0.00	34.46	36.12
120109	16.09	72.07	36.59	73.72	58.47
120110	85.71	33.79	0.00	33.85	82.83

Table 6-3. WLAs for BOD_5 for subsegment 120102 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LA0003034	001	Alma Plantation, Ltd -Pointe County	17	5	709.36
LA0003034	003	Alma Plantation, Ltd -Pointe County	14	5	584.18
LAG531203	001	Jannet's Trailer Park	0.003	45	1.13
LAG531500	001	Hidden Oaks Mobile Home	0.0045	45	1.69
LAG531697	001	Iberville Parish Council	0.00074	45	0.28
LAG531903	001	Dollar Variety, LLC	0.00006	45	0.02

Table 6-3. (continued)

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LAG531990	001	Club Combination	0.001635	45	0.61
LAG540069	001	190 Quick Mart, Inc.	0.003017	45	1.13
LAG540785	001	West Baton Rouge Ph Nat Gas & Water	0.012	45	4.51
LAG540858	001	Ewing's of New Roads, Inc.	0.00636	45	2.39
LAG540898	001	State Capitol Dragway NHRA	0.04	45	15.02
LAG750164	001	V&G Laundry	0.0001	45	0.04
		Total	31.07141	--	1,320.36

Table 6-4. WLAs for ammonia for subsegment 120102 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	NH_3 (mg/L)	NH_3 (lb/d)
LA0003034	001	Alma Plantation, Ltd -Pointe County	17	1.25	177.34
LA0003034	003	Alma Plantation, Ltd -Pointe County	14	1.25	146.04
LAG531203	001	Jannet's Trailer Park	0.003	15.00	0.38
LAG531500	001	Hidden Oaks Mobile Home	0.0045	15.00	0.56
LAG531697	001	Iberville Parish Council	0.00074	15.00	0.09
LAG531903	001	Dollar Variety, LLC	0.00006	15.00	0.01
LAG531990	001	Club Combination	0.001635	15.00	0.20
LAG540069	001	190 Quick Mart, Inc.	0.003017	15.00	0.38
LAG540785	001	West Baton Rouge Ph Nat Gas & Water	0.012	15.00	1.50
LAG540858	001	Ewing's of New Roads, Inc.	0.00636	15.00	0.80
LAG540898	001	State Capitol Dragway NHRA	0.04	15.00	5.01
LAG750164	001	V&G Laundry	0.0001	15.00	0.01
		Total	31.07141	--	332.32

Table 6-5. WLAs for organic nitrogen for subsegment 120102 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	Org N (mg/L)	Org N (lb/d)
LA0003034	001	Alma Plantation, Ltd -Pointe County	17	0.83	117.75
LA0003034	003	Alma Plantation, Ltd -Pointe County	14	0.83	96.97
LAG531203	001	Jannet's Trailer Park	0.003	7.50	0.19
LAG531500	001	Hidden Oaks Mobile Home	0.0045	7.50	0.28
LAG531697	001	Iberville Parish Council	0.00074	7.50	0.05
LAG531903	001	Dollar Variety, LLC	0.00006	7.50	0.00
LAG531990	001	Club Combination	0.001635	7.50	0.10
LAG540069	001	190 Quick Mart, Inc.	0.003017	7.50	0.19
LAG540785	001	West Baton Rouge Ph Nat Gas & Water	0.012	7.50	0.75
LAG540858	001	Ewing's of New Roads, Inc.	0.00636	7.50	0.40
LAG540898	001	State Capitol Dragway NHRA	0.04	7.50	2.50
LAG750164	001	V&G Laundry	0.0001	7.50	0.01
		Total	31.07141	--	949.12

Table 6-6. WLAs for BOD_5 for subsegment 120103 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LA0103586	001	Basf Catalysts, LLC - Port Allen Works	0.0012	45	0.45
LA0117773	001	Fluker's Cricket Farm, Inc.	0.003	45	1.13
LA0117773	002	Fluker's Cricket Farm, Inc.	0.0006	45	0.23
LAG480101	001	United ANCO Insulations, Inc.	0.0015	45	0.56
LAG480165	001	TMI Enterprise, LLC	0.000952	45	0.36
LAG480175	001	Specialty Application Services, Inc. - Port Allen Facility	0.00006	45	0.02
LAG480179		Oil Mop, LLC	0.0004	45	0.15
LAG480182	001	Industrial Parts Specialties	0.0015	45	0.56
LAG480386		Westside Galvanizing Svcs	0.0008	45	0.3
LAG480404		Asphalt Products Unlimited	0.0001	45	0.04
LAG480538	001	Shaw SSS Fabricators, Inc.	0.0005	45	0.19
LAG480538	002	Shaw SSS Fabricators, Inc.	0.0015	45	0.56
LAG530126		Garman LLC	0.005	45	1.88
LAG530361	001	MCBR Management Co, Inc. - McDonald's Restaurant	0.005	45	1.88
LAG530639		Westerner Motel	0.005	45	1.88
LAG531054		Heyman-Moore Transport, Inc.	0.005	45	1.88
LAG531121		Waffle House Miller Properties	0.00255	45	0.96
LAG531384		Bergeron's Boudin & Cajun	0.00036	45	0.14
LAG531623		Circle K, Inc.	0.00091	45	0.34
LAG531726		American General Investments - Cracker Barrel	0.0015	45	0.56
LAG540027		Krawdaddys Deli & Restaurant	0.01444	45	5.41
LAG540089		415 Trailer Park	0.00925	45	3.47
LAG540205		Cajun Country Campground, Inc.	0.00975	45	3.66
LAG540264		Days Inn of Port Allen	0.01835	45	6.89
LAG540342		West Baton Rouge Parish Work Release Gulf Coast Correct	0.009	45	3.38
LAG540387	001	Iberville Ph School Board	0.01502	45	5.64
LAG540510		Hari Ohm Hospitality, Inc.	0.0072	45	2.7
LAG540584		Pointe Coupee Sew Svc	0.0236	45	8.86
LAG540775		W Baton Rouge Ph School Board	0.0068	45	2.55
LAG540851		Acadian Mobile Home Park	0.00432	45	1.62
LAG540856		West Baton Rouge Par Sch Bd	0.025	45	9.39
LAG541036	001	West Baton Rouge Auto Salvage - Wrecker & LaComb's Trailer Park	0.0069	45	2.59
LAG541051		Sunrise Village Mobile Home Park - Izzy & Elliot, LLC	0.0108	45	4.06
LAG541218		Legacy Trailer Park	0.0075	45	2.82
LAG541313		Mo-Dad Utilities, LLC - West Lake Subdivision	0.0248	45	9.31
LAG560148		West Baton Rouge Par Nat Gas & Wtr - Blanchard Estates	0.04	30	10.01
LAG560149		West Baton Rouge Parish Police Detention and Law Enforcement Center	0.032434	30	8.12

Table 6-6. (continued)

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LAG560189		West Baton Rouge Par Utilities Dept - Roseland Trace Subd	0.03	30	7.51
LAG570331		West Baton Rouge Natural Gas and Water Systems - Mulatto Bend WWTF	0.03	23	5.76
LAG750279		Hulcher SVC INC	0.00006	45	0.02
LAG750453		Louisiana Scrap Metal	0.0008	45	0.30
		Total	0.3635	--	118.15

Table 6-7. WLAs for ammonia for subsegment 120103 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	NH_3 (mg/L)	NH_3 (lb/d)
LA0103586	001	Basf Catalysts, LLC - Port Allen Works	0.0012	15.00	0.15
LA0117773	001	Fluker's Cricket Farm, Inc.	0.003	15.00	0.38
LA0117773	002	Fluker's Cricket Farm, Inc.	0.0006	15.00	0.08
LAG480101	001	United ANCO Insulations, Inc.	0.0015	15.00	0.19
LAG480165	001	TMI Enterprise, LLC	0.000952	15.00	0.12
LAG480175	001	Specialty Application Services, Inc. - Port Allen Facility	0.00006	15.00	0.01
LAG480179		Oil Mop, LLC	0.0004	15.00	0.05
LAG480182	001	Industrial Parts Specialties	0.0015	15.00	0.19
LAG480386		Westside Galvanizing Svcs	0.0008	15.00	0.10
LAG480404		Asphalt Products Unlimited	0.0001	15.00	0.01
LAG480538	001	Shaw SSS Fabricators, Inc.	0.0005	15.00	0.06
LAG480538	002	Shaw SSS Fabricators, Inc.	0.0015	15.00	0.19
LAG530126		Garman LLC	0.005	15.00	0.63
LAG530361	001	MCBR Management Co, Inc. - McDonald's Restaurant	0.005	15.00	0.63
LAG530639		Westerner Motel	0.005	15.00	0.63
LAG531054		Heyman-Moore Transport, Inc.	0.005	15.00	0.63
LAG531121		Waffle House Miller Properties	0.00255	15.00	0.32
LAG531384		Bergeron's Boudin & Cajun	0.00036	15.00	0.05
LAG531623		Circle K, Inc.	0.00091	15.00	0.11
LAG531726		American General Investments - Cracker Barrel	0.0015	15.00	0.19
LAG540027		Krawdaddys Deli & Restaurant	0.01444	15.00	1.80
LAG540089		415 Trailer Park	0.00925	15.00	1.16
LAG540205		Cajun Country Campground, Inc.	0.00975	15.00	1.22
LAG540264		Days Inn of Port Allen	0.01835	15.00	2.30
LAG540342		West Baton Rouge Parish Work Release Gulf Coast Correct	0.009	15.00	1.13
LAG540387	001	Iberville Ph School Board	0.01502	15.00	1.88
LAG540510		Hari Ohm Hospitality, Inc.	0.0072	15.00	0.90
LAG540584		Pointe Coupee Sew Svc	0.0236	15.00	2.95
LAG540775		W Baton Rouge Ph School Board	0.0068	15.00	0.85
LAG540851		Acadian Mobile Home Park	0.00432	15.00	0.54
LAG540856		West Baton Rouge Par Sch Bd	0.025	15.00	3.13

Table 6-7. (continued)

NPDES permit number	Outfall	Facility name	Flow (mgd)	NH_3 (mg/L)	NH_3 (lb/d)
LAG541036	001	West Baton Rouge Auto Salvage - Wrecker & LaComb's Trailer Park	0.0069	15.00	0.86
LAG541051		Sunrise Village Mobile Home Park - Izzy & Elliot, LLC	0.0108	15.00	1.35
LAG541218		Legacy Trailer Park	0.0075	15.00	0.94
LAG541313		Mo-Dad Utilities, LLC - West Lake Subdivision	0.0248	15.00	3.10
LAG560148		West Baton Rouge Par Nat Gas & Wtr - Blanchard Estates	0.04	10.00	3.34
LAG560149		West Baton Rouge Parish Police Detention and Law Enforcement Center	0.032434	10.00	2.71
LAG560189		West Baton Rouge Par Utilities Dept - Roseland Trace Subd	0.03	10.00	2.50
LAG570331		West Baton Rouge Natural Gas and Water Systems - Mulatto Bend WWTF	0.03	7.67	1.92
LAG750279		Hulcher SVC INC	0.00006	15.00	0.01
LAG750453		Louisiana Scrap Metal	0.0008	15.00	0.10
		Total	0.3635	--	170.53

Table 6-8. WLAs for organic nitrogen for subsegment 120103 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	Org N (mg/L)	Org N (lb/d)
LA0103586	001	Basf Catalysts, LLC - Port Allen Works	0.0012	7.50	0.08
LA0117773	001	Fluker's Cricket Farm, Inc.	0.003	7.50	0.19
LA0117773	002	Fluker's Cricket Farm, Inc.	0.0006	7.50	0.04
LAG480101	001	United ANCO Insulations, Inc.	0.0015	7.50	0.09
LAG480165	001	TMI Enterprise, LLC	0.000952	7.50	0.06
LAG480175	001	Specialty Application Services, Inc. - Port Allen Facility	0.00006	7.50	0.00
LAG480179		Oil Mop, LLC	0.0004	7.50	0.03
LAG480182	001	Industrial Parts Specialties	0.0015	7.50	0.09
LAG480386		Westside Galvanizing Svcs	0.0008	7.50	0.05
LAG480404		Asphalt Products Unlimited	0.0001	7.50	0.01
LAG480538	001	Shaw SSS Fabricators, Inc.	0.0005	7.50	0.03
LAG480538	002	Shaw SSS Fabricators, Inc.	0.0015	7.50	0.09
LAG530126		Garman LLC	0.005	7.50	0.31
LAG530361	001	MCBR Management Co, Inc. - McDonald's Restaurant	0.005	7.50	0.31
LAG530639		Westerner Motel	0.005	7.50	0.31
LAG531054		Heyman-Moore Transport, Inc.	0.005	7.50	0.31
LAG531121		Waffle House Miller Properties	0.00255	7.50	0.16
LAG531384		Bergeron's Boudin & Cajun	0.00036	7.50	0.02
LAG531623		Circle K, Inc.	0.00091	7.50	0.06
LAG531726		American General Investments - Cracker Barrel	0.0015	7.50	0.09
LAG540027		Krawdaddys Deli & Restaurant	0.01444	7.50	0.90
LAG540089		415 Trailer Park	0.00925	7.50	0.58

Table 6-8. (continued)

NPDES permit number	Outfall	Facility name	Flow (mgd)	Org N (mg/L)	Org N (lb/d)
LAG540205		Cajun Country Campground, Inc.	0.00975	7.50	0.61
LAG540264		Days Inn of Port Allen	0.01835	7.50	1.15
LAG540342		West Baton Rouge Parish Work Release Gulf Coast Correct	0.009	7.50	0.56
LAG540387	001	Iberville Ph School Board	0.01502	7.50	0.94
LAG540510		Hari Ohm Hospitality, Inc.	0.0072	7.50	0.45
LAG540584		Pointe Coupee Sew Svc	0.0236	7.50	1.48
LAG540775		W Baton Rouge Ph School Board	0.0068	7.50	0.43
LAG540851		Acadian Mobile Home Park	0.00432	7.50	0.27
LAG540856		West Baton Rouge Par Sch Bd	0.025	7.50	1.56
LAG541036	001	West Baton Rouge Auto Salvage - Wrecker & LaComb's Trailer Park	0.0069	7.50	0.43
LAG541051		Sunrise Village Mobile Home Park - Izzy & Elliot, LLC	0.0108	7.50	0.68
LAG541218		Legacy Trailer Park	0.0075	7.50	0.47
LAG541313		Mo-Dad Utilities, LLC - West Lake Subdivision	0.0248	7.50	1.55
LAG560148		West Baton Rouge Par Nat Gas & Wtr - Blanchard Estates	0.04	5.00	1.67
LAG560149		West Baton Rouge Parish Police Detention and Law Enforcement Center	0.032434	5.00	1.35
LAG560189		West Baton Rouge Par Utilities Dept - Roseland Trace Subd	0.03	5.00	1.25
LAG570331		West Baton Rouge Natural Gas and Water Systems - Mulatto Bend WWTF	0.03	3.83	0.96
LAG750279		Hulcher SVC INC	0.00006	7.50	0.00
LAG750453		Louisiana Scrap Metal	0.0008	7.50	0.05
		Total	0.3635	--	85.26

Table 6-9. WLAs for BOD_5 for subsegment 120105 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LA0121185	002	Air Liquide America LP	0.00002	45	0.01
LAG530786	001	West Baton Rouge Par Sch Bd - Chamberlin Elem. School	0.005	45	1.88
LAG540581	001	Pointe Coupee Par Sch Bd - Rougon Elementary School	0.014	45	5.26
LAG540775	001	West Baton Rouge Par Sch Bd - Devall Middle School	0.0068	45	2.55
LAG540783	001	West Baton Rouge Ph Natural Gas & Wtr Sys - Ashland Plantation WWTP	0.049	10	4.09
LAG540784	001	West Baton Rouge Comm Cntr	0.005	45	1.88
		Total	0.0798	--	15.66

Table 6-10. WLAs for ammonia for subsegment 120105 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	NH_3 (mg/L)	NH_3 (lb/d)
LA0121185	002	Air Liquide America LP	0.00002	15.00	0.00
LAG530786	001	West Baton Rouge Par Sch Bd - Chamberlin Elem. School	0.005	15.00	0.63
LAG540581	001	Pointe Coupee Par Sch Bd - Rougon Elementary School	0.014	15.00	1.75
LAG540775	001	West Baton Rouge Par Sch Bd - Devall Middle School	0.0068	15.00	0.85
LAG540783	001	West Baton Rouge Ph Natural Gas & Wtr Sys - Ashland Plantation WWTP	0.049	3.33	1.36
LAG540784	001	West Baton Rouge Comm Cntr	0.005	15.00	0.63
		Total	0.0798	--	22.61

Table 6-11. WLAs for organic nitrogen for subsegment 120105 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	Org N (mg/L)	Org N (lb/d)
LA0121185	002	Air Liquide America LP	0.00002	7.50	0.00
LAG530786	001	West Baton Rouge Par Sch Bd - Chamberlin Elem. School	0.005	7.50	0.31
LAG540581	001	Pointe Coupee Par Sch Bd - Rougon Elementary School	0.014	7.50	0.88
LAG540775	001	West Baton Rouge Par Sch Bd - Devall Middle School	0.0068	7.50	0.43
LAG540783	001	West Baton Rouge Ph Natural Gas & Wtr Sys - Ashland Plantation WWTP	0.049	1.67	0.68
LAG540784	001	West Baton Rouge Comm Cntr	0.005	7.50	0.31
		Total	0.0798	--	11.30

Table 6-12. WLAs for BOD_5 for subsegment 120106 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LA0020648	001	Plaquemine, City of	1.5	30	375.54
LAG531065	001	Iberville Parish Parks & Rec	0.005	45	1.88
LAG531912	001	Eagle Warehouse	0.00004	45	0.02
LAG531912	002	Eagle Warehouse	0.00036	45	0.14
LAG540102		TesH-Green Acres	0.024	45	9.01
LAG540118	001	River West Medical Ctr	0.007777	45	2.92
LAG540384	001	Crescent Elementary School	0.0026	45	0.98
LAG570359	001	Iberville Parish Council - Patureau Lane Sewer	0.065	15	8.14
		Total	1.605	--	398.62

Table 6-13. WLAs for ammonia for subsegment 120106 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	NH_3 (mg/L)	NH_3 (lb/d)
LA0020648	001	Plaquemine, City of	1.5	4.00	50.07
LAG531065	001	Iberville Parish Parks & Rec	0.005	15.00	0.63
LAG531912	001	Eagle Warehouse	0.00004	15.00	0.01
LAG531912	002	Eagle Warehouse	0.00036	15.00	0.05
LAG540102		TesH-Green Acres	0.024	15.00	3.00
LAG540118	001	River West Medical Ctr	0.007777	15.00	0.97
LAG540384	001	Crescent Elementary School	0.0026	15.00	0.33
LAG570359	001	Iberville Parish Council - Patureau Lane Sewer	0.065	5.00	2.71
		Total	1.605	--	250.12

Table 6-14. WLAs for organic nitrogen for subsegment 120106 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	Org N (mg/L)	Org N (lb/d)
LA0020648	001	Plaquemine, City of	1.5	3.00	37.55
LAG531065	001	Iberville Parish Parks & Rec	0.005	7.50	0.31
LAG531912	001	Eagle Warehouse	0.00004	7.50	0.00
LAG531912	002	Eagle Warehouse	0.00036	7.50	0.02
LAG540102		TesH-Green Acres	0.024	7.50	1.50
LAG540118	001	River West Medical Ctr	0.007777	7.50	0.49
LAG540384	001	Crescent Elementary School	0.0026	7.50	0.16
LAG570359	001	Iberville Parish Council - Patureau Lane Sewer	0.065	2.50	1.36
		Total	1.605	--	179.26

Table 6-15. WLAs for BOD_5 for subsegment 120109 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LA0047554	001	Sid Richardson Carbon Co.	0.002	45	0.75
LA0052124	004	Intercontinental Terminals Co.	0.0005	45	0.19
LA0068241	001	Brusly, Town of	0.22298	15	27.91
LA0068501	001	West Baton Rouge Ph - Westport	0.4	15	50.07
LA0080888	001	Westway Trading Company - Port Allen Terminal	0.0001	45	0.04
LA0080888	004	Westway Trading Company - Port Allen Terminal	0.00005	45	0.02
LA0083721	001	Trinity Marine Products	0.005	45	1.88
LA0083721	002	Trinity Marine Products	0.0015	45	0.56
LA0083721	003	Trinity Marine Products	0.01	45	3.76
LA0085821	201	EXXON Port Allen Lube Plant	0.003	45	1.13
LA0104159	001	Trans Chem - Port Allen	0.00034	45	0.13
LA0107719	001	Nalco Company	0.03	36	9.01
LA0107719	002	Nalco Company	0.0002	45	0.08
LA0108685	002	Andrews Transports	0.0005	45	0.19
LA0114324	001	Community Coffee Co., LLC	0.002	45	0.75
LAG110020	001	Construction Specialists	0.002	45	0.75
LAG380068	003	Iberville Par Waterworks	0.005	45	1.88
LAG480154	001	Diamond Plastics Corp	0.00084	45	0.32
LAG480189	001	Reliant Technologies	0.000072	45	0.03

Table 6-15. (continued)

NPDES permit number	Outfall	Facility name	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (lb/d)
LAG480217	004	Southern Scrap Xpress	0.000309	45	0.12
LAG480441	002	Wal-Mart Stores, Inc.	0.005	45	1.88
LAG480540	001	US Dept of Energy Strategic Petroleum Reserve - Bayou Choctaw Storage Facility	0.00083	45	0.31
LAG480540	002	US Dept of Energy Strategic Petroleum Reserve - Bayou Choctaw Storage Facility	0.00083	45	0.31
LAG530594	001	Waffle House #1016	0.005	45	1.88
LAG530620	001	Ourso Trailer Park Brusly	0.005	45	1.88
LAG531026	001	Brusly Apts	0.002	45	0.75
LAG531056	001	Greater Baton Rouge Port Commission	0.0005	45	0.19
LAG531056	002	Greater Baton Rouge Port Commission	0.0005	45	0.19
LAG531095	001	Lyons Specialty Co., Inc.	0.003162	45	1.19
LAG531167	001	Leo Wallace Daiquiries	0.00105	45	0.39
LAG531168	001	Lucky Dollar Casino	0.005	45	1.88
LAG531169	001	Port Allen Inn Suites	0.0048	45	1.80
LAG531231	001	Poplar Grove Chapel Missionary Baptist Church	0.005	45	1.88
LAG531362	001	LA DOTD	0.0025	45	0.94
LAG531616	001	Thomas Pipe & Steel, LLC	0.0003	45	0.11
LAG531756	001	Dollar Distributing, Inc.	0.0041	45	1.54
LAG532260	003	Distribution International	0.005	45	1.88
LAG532260	101	Distribution International	0.0006	45	0.23
LAG532260	102	Distribution International	0.0015	45	0.56
LAG540359	001	Best Western Magnolia Manor	0.016525	45	6.21
LAG540627	001	S&R Mobile Home Park	0.015	45	5.63
LAG540786	001	West Baton Rouge Ph Nat Gas & Wtr - Oak Alley Subdivision	0.0156	45	5.86
LAG540921	001	West Baton Rouge Ph Nat Gas & Wtr - Brittany Estates	0.006	45	2.25
LAG540994	001	Chinese Inn	0.00575	45	2.16
LAG540998	001	West Baton Rouge Work Release Ctr	0.00974	45	3.66
LAG541105	001	Cash's Casino, Inc.	0.00908	45	3.41
LAG560147	001	West Baton Rouge Natural Gas And Water Systems - Riverside Dr	0.035	30	8.76
LAG560191	001	West Baton Rouge Ph Nat Gas & Wtr	0.036	30	9.01
LAG560192	001	Timberlane Trailer Park Oxidation Pond	0.0384	30	9.61
LAG560237	001	West Baton Rouge Parish - Freeman Lane WWTP	0.025	30	6.26
LAG570151	001	West Baton Rouge Nat Gas And Wtr - Fairview Estates Subdivision	0.09	15	11.27
LAG570355	001	West Baton Rouge Parish Utilities, Beaulieu STP No. 1	0.025	15	3.13
LAG570356	001	Choctaw MHP, LLC	0.0609	15	7.62
LAG750188	002	Corps of Engineers - Bayou Sorrel Lock	0.00008	45	0.03
		Total	1.127	--	204.20

Table 6-16. WLAs for ammonia for subsegment 120109 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	NH_3 (mg/L)	NH_3 (lb/d)
LA0047554	001	Sid Richardson Carbon Co.	0.002	15.00	0.25
LA0052124	004	Intercontinental Terminals Co.	0.0005	15.00	0.06
LA0068241	001	Brusly, Town of	0.22298	5.46	10.16
LA0068501	001	West Baton Rouge Ph - Westport	0.4	5.00	16.69
LA0080888	001	Westway Trading Company - Port Allen Terminal	0.0001	15.00	0.01
LA0080888	004	Westway Trading Company - Port Allen Terminal	0.00005	15.00	0.01
LA0083721	001	Trinity Marine Products	0.005	15.00	0.63
LA0083721	002	Trinity Marine Products	0.0015	15.00	0.19
LA0083721	003	Trinity Marine Products	0.01	15.00	1.25
LA0085821	201	EXXON Port Allen Lube Plant	0.003	15.00	0.38
LA0104159	001	Trans Chem - Port Allen	0.00034	15.00	0.04
LA0107719	001	Nalco Company	0.03	12.00	3.00
LA0107719	002	Nalco Company	0.0002	15.00	0.03
LA0108685	002	Andrews Transports	0.0005	15.00	0.06
LA0114324	001	Community Coffee Co., LLC	0.002	15.00	0.25
LAG110020	001	Construction Specialists	0.002	15.00	0.25
LAG380068	003	Iberville Par Waterworks	0.005	15.00	0.63
LAG480154	001	Diamond Plastics Corp	0.00084	15.00	0.11
LAG480189	001	Reliant Technologies	0.000072	15.00	0.01
LAG480217	004	Southern Scrap Xpress	0.000309	15.00	0.04
LAG480441	002	Wal-Mart Stores, Inc.	0.005	15.00	0.63
LAG480540	001	US Dept of Energy Strategic Petroleum Reserve - Bayou Choctaw Storage Facility	0.00083	15.00	0.10
LAG480540	002	US Dept of Energy Strategic Petroleum Reserve - Bayou Choctaw Storage Facility	0.00083	15.00	0.10
LAG530594	001	Waffle House #1016	0.005	15.00	0.63
LAG530620	001	Ourso Trailer Park Brusly	0.005	15.00	0.63
LAG531026	001	Brusly Apts	0.002	15.00	0.25
LAG531056	001	Greater Baton Rouge Port Commission	0.0005	15.00	0.06
LAG531056	002	Greater Baton Rouge Port Commission	0.0005	15.00	0.06
LAG531095	001	Lyons Specialty Co., Inc.	0.003162	15.00	0.40
LAG531167	001	Leo Wallace Daiquiries	0.00105	15.00	0.13
LAG531168	001	Lucky Dollar Casino	0.005	15.00	0.63
LAG531169	001	Port Allen Inn Suites	0.0048	15.00	0.60
LAG531231	001	Poplar Grove Chapel Missionary Baptist Church	0.005	15.00	0.63
LAG531362	001	LA DOTD	0.0025	15.00	0.31
LAG531616	001	Thomas Pipe & Steel, LLC	0.0003	15.00	0.04
LAG531756	001	Dollar Distributing, Inc.	0.0041	15.00	0.51
LAG532260	003	Distribution International	0.005	15.00	0.63
LAG532260	101	Distribution International	0.0006	15.00	0.08
LAG532260	102	Distribution International	0.0015	15.00	0.19
LAG540359	001	Best Western Magnolia Manor	0.016525	15.00	2.07
LAG540627	001	S&R Mobile Home Park	0.015	15.00	1.88
LAG540786	001	West Baton Rouge Ph Nat Gas & Wtr - Oak Alley Subdivision	0.0156	15.00	1.95
LAG540921	001	West Baton Rouge Ph Nat Gas & Wtr - Brittany Estates	0.006	15.00	0.75
LAG540994	001	Chinese Inn	0.00575	15.00	0.72
LAG540998	001	West Baton Rouge Work Release Ctr	0.00974	15.00	1.22

Table 6-16. (continued)

NPDES permit number	Outfall	Facility name	Flow (mgd)	NH_3 (mg/L)	NH_3 (lb/d)
LAG541105	001	Cash's Casino, Inc.	0.00908	15.00	1.14
LAG560147	001	West Baton Rouge Natural Gas And Water Systems - Riverside Dr	0.035	10.00	2.92
LAG560191	001	West Baton Rouge Ph Nat Gas & Wtr	0.036	10.00	3.00
LAG560192	001	Timberlane Trailer Park Oxidation Pond	0.0384	10.00	3.20
LAG560237	001	West Baton Rouge Parish - Freeman Lane WWTP	0.025	10.00	2.09
LAG570151	001	West Baton Rouge Nat Gas And Wtr - Fairview Estates Subdivision	0.09	5.00	3.76
LAG570355	001	West Baton Rouge Parish Utilities, Beaulieu STP No. 1	0.025	5.00	1.04
LAG570356	001	Choctaw MHP, LLC	0.0609	5.00	2.54
LAG750188	002	Corps of Engineers - Bayou Sorrel Lock	0.00008	15.00	0.01
		Total	1.127	--	298.44

Table 6-17. WLAs for organic nitrogen for subsegment 120109 in the upper Terrebonne Basin

NPDES permit number	Outfall	Facility name	Flow (mgd)	Org N (mg/L)	Org N (lb/d)
LA0047554	001	Sid Richardson Carbon Co.	0.002	7.50	0.13
LA0052124	004	Intercontinental Terminals Co.	0.0005	7.50	0.03
LA0068241	001	Brusly, Town of	0.22298	2.73	5.08
LA0068501	001	West Baton Rouge Ph - Westport	0.4	2.50	8.35
LA0080888	001	Westway Trading Company - Port Allen Terminal	0.0001	7.50	0.01
LA0080888	004	Westway Trading Company - Port Allen Terminal	0.00005	7.50	0.00
LA0083721	001	Trinity Marine Products	0.005	7.50	0.31
LA0083721	002	Trinity Marine Products	0.0015	7.50	0.09
LA0083721	003	Trinity Marine Products	0.01	7.50	0.63
LA0085821	201	EXXON Port Allen Lube Plant	0.003	7.50	0.19
LA0104159	001	Trans Chem - Port Allen	0.00034	7.50	0.02
LA0107719	001	Nalco Company	0.03	6.00	1.50
LA0107719	002	Nalco Company	0.0002	7.50	0.01
LA0108685	002	Andrews Transports	0.0005	7.50	0.03
LA0114324	001	Community Coffee Co., LLC	0.002	7.50	0.13
LAG110020	001	Construction Specialists	0.002	7.50	0.13
LAG380068	003	Iberville Par Waterworks	0.005	7.50	0.31
LAG480154	001	Diamond Plastics Corp	0.00084	7.50	0.05
LAG480189	001	Reliant Technologies	0.000072	7.50	0.00
LAG480217	004	Southern Scrap Xpress	0.000309	7.50	0.02
LAG480441	002	Wal-Mart Stores, Inc.	0.005	7.50	0.31
LAG480540	001	US Dept of Energy Strategic Petroleum Reserve - Bayou Choctaw Storage Facility	0.00083	7.50	0.05
LAG480540	002	US Dept of Energy Strategic Petroleum Reserve - Bayou Choctaw Storage Facility	0.00083	7.50	0.05
LAG530594	001	Waffle House #1016	0.005	7.50	0.31
LAG530620	001	Ourso Trailer Park Brusly	0.005	7.50	0.31
LAG531026	001	Brusly Apts	0.002	7.50	0.13
LAG531056	001	Greater Baton Rouge Port Commission	0.0005	7.50	0.03
LAG531056	002	Greater Baton Rouge Port Commission	0.0005	7.50	0.03
LAG531095	001	Lyons Specialty Co., Inc.	0.003162	7.50	0.20

Table 6-17. (continued)

NPDES permit number	Outfall	Facility name	Flow (mgd)	Org N (mg/L)	Org N (lb/d)
LAG531167	001	Leo Wallace Daiquiries	0.00105	7.50	0.07
LAG531168	001	Lucky Dollar Casino	0.005	7.50	0.31
LAG531169	001	Port Allen Inn Suites	0.0048	7.50	0.30
LAG531231	001	Poplar Grove Chapel Missionary Baptist Church	0.005	7.50	0.31
LAG531362	001	LA DOTD	0.0025	7.50	0.16
LAG531616	001	Thomas Pipe & Steel, LLC	0.0003	7.50	0.02
LAG531756	001	Dollar Distributing, Inc.	0.0041	7.50	0.26
LAG532260	003	Distribution International	0.005	7.50	0.31
LAG532260	101	Distribution International	0.0006	7.50	0.04
LAG532260	102	Distribution International	0.0015	7.50	0.09
LAG540359	001	Best Western Magnolia Manor	0.016525	7.50	1.03
LAG540627	001	S&R Mobile Home Park	0.015	7.50	0.94
LAG540786	001	West Baton Rouge Ph Nat Gas & Wtr - Oak Alley Subdivision	0.0156	7.50	0.98
LAG540921	001	West Baton Rouge Ph Nat Gas & Wtr - Brittany Estates	0.006	7.50	0.38
LAG540994	001	Chinese Inn	0.00575	7.50	0.36
LAG540998	001	West Baton Rouge Work Release Ctr	0.00974	7.50	0.61
LAG541105	001	Cash's Casino, Inc.	0.00908	7.50	0.57
LAG560147	001	West Baton Rouge Natural Gas And Water Systems - Riverside Dr	0.035	5.00	1.46
LAG560191	001	West Baton Rouge Ph Nat Gas & Wtr	0.036	5.00	1.50
LAG560192	001	Timberlane Trailer Park Oxidation Pond	0.0384	5.00	1.60
LAG560237	001	West Baton Rouge Parish - Freeman Lane WWTP	0.025	5.00	1.04
LAG570151	001	West Baton Rouge Nat Gas And Wtr - Fairview Estates Subdivision	0.09	2.50	1.88
LAG570355	001	West Baton Rouge Parish Utilities, Beaulieu STP No. 1	0.025	2.50	0.52
LAG570356	001	Choctaw MHP, LLC	0.0609	2.50	1.27
LAG750188	002	Corps of Engineers - Bayou Sorrel Lock	0.00008	7.50	0.01
		Total	1.127	--	149.22

Table 6-18. Summary of WLAs for MS4s in the upper Terrebonne Basin

Subsegment	Urban Area (UA)	NPDES	MS4 area (acres)	Pollutant	MS4 (lb/d)
120103	Port Allen	LAR0410102	1,405.01	BOD_u	97.89
120103	Port Allen	LAR0410102	1,405.01	Organic nitrogen	10.02
120103	Port Allen	LAR0410102	1,405.01	Ammonia	13.83
120103	Port Allen	LAR0410102	1,405.01	SOD	63.34
120109	Port Allen	LAR0410102	425.60	BOD_u	44.61
120109	Port Allen	LAR0410102	425.60	Organic nitrogen	14.24
120109	Port Allen	LAR0410102	425.60	Ammonia	1.25
120109	Port Allen	LAR0410102	425.60	SOD	107.90

6.1.1 Seasonal Variation

Critical conditions for dissolved oxygen in Louisiana waterbodies have been determined to be the following: negligible nonpoint runoff and low stream flow combined with high water temperatures. Oxygen-demanding substances can enter a water system during high flows and settle to the bottom, where they exert a large oxygen demand during the high-temperature/low-flow seasons. Water temperature is one of the leading factors that affect dissolved oxygen in the three segments. High water temperatures lower the dissolved oxygen saturation concentration, decreasing the amount of dissolved oxygen that the stream can contain. In addition, high temperature increases CBOD decay and SOD. Therefore, it is most important to develop a TMDL to address the high-water-temperature conditions.

6.1.2 Sensitivity Analysis

A sensitivity analysis was performed on the model parameters using the sensitivity function built into LA-QUAL. LA-QUAL automatically changed the requested parameters by a set amount while keeping all other parameters constant. The calibration scenario was used as the baseline for the sensitivity analysis. For the analysis, all parameters were varied by ±30 percent. The results for dissolved oxygen and BOD are shown in Table 6-19. Result plots are shown in Appendix K. Changes to the stream reaeration, stream velocity, and background SOD had the largest influence on dissolved oxygen levels. Stream dispersion had no effect on dissolved oxygen.

Table 6-19. Results of sensitivity analysis

		BOD (mg/L)						DO (mg/L)					
		BOD aerobic decay rate	BOD settling rate	Stream dispersion	Stream reaeration	Background SOD	Stream velocity	BOD aerobic decay rate	BOD settling rate	Stream dispersion	Stream reaeration	Background SOD	Stream velocity
120102	-30%	27.42	26.12	26.12	26.15	26.13	24.36	0.30	0.30	0.30	0.30	0.30	0.30
	base	26.12	26.12	26.12	26.12	26.12	26.12	0.30	0.30	0.30	0.30	0.30	0.30
	30%	24.89	26.12	26.12	26.11	26.12	27.12	0.30	0.30	0.30	0.30	0.30	0.30
120103	-30%	7.16	6.64	6.64	6.64	6.64	6.01	2.77	2.06	2.06	1.59	2.94	1.84
	base	6.64	6.64	6.64	6.64	6.64	6.64	2.06	2.06	2.06	2.06	2.06	2.06
	30%	6.19	6.64	6.64	6.64	6.64	7.03	1.74	2.06	2.06	2.81	1.65	2.37
120105	-30%	9.26	6.84	6.84	6.84	6.84	4.90	2.10	2.10	2.10	2.09	2.10	2.10
	base	6.84	6.84	6.84	6.84	6.84	6.84	2.10	2.10	2.10	2.10	2.10	2.10
	30%	5.36	6.84	6.84	6.84	6.84	8.58	2.10	2.10	2.10	2.10	2.10	2.10
120106	-30%	4.93	4.9	4.93	4.93	4.93	4.93	3.75	2.70	2.70	1.67	3.01	2.92
	base	4.93	4.93	4.93	4.93	4.93	4.93	2.70	2.70	2.70	2.70	2.70	2.70
	30%	4.93	4.93	4.93	4.93	4.93	4.93	1.91	2.70	2.70	3.51	2.39	2.74
120107	-30%	9.58	7.89	7.89	7.89	7.89	5.98	3.30	3.07	3.07	2.27	3.30	2.91
	base	7.89	7.89	7.89	7.89	7.89	7.89	3.07	3.07	3.07	3.07	3.07	3.07
	30%	6.49	7.89	7.89	7.89	7.89	9.16	2.55	3.07	3.07	3.30	2.58	3.26

Table 6-19. (continued)

		BOD (mg/L)						DO (mg/L)					
		BOD aerobic decay rate	BOD settling rate	Stream dispersion	Stream reaeration	Background SOD	Stream velocity	BOD aerobic decay rate	BOD settling rate	Stream dispersion	Stream reaeration	Background SOD	Stream velocity
120109	-30%	2.13	1.74	1.74	1.74	1.74	1.32	2.26	2.06	2.06	1.34	2.62	2.59
	base	1.74	1.74	1.74	1.74	1.74	1.74	2.06	2.06	2.06	2.06	2.06	2.06
	30%	1.43	1.74	1.74	1.74	1.74	2.03	2.02	2.06	2.06	2.96	1.70	1.86
120110	-30%	4.65	4.62	4.62	4.62	4.62	4.59	4.10	4.10	4.10	3.85	4.10	4.10
	base	4.62	4.62	4.62	4.62	4.62	4.62	4.10	4.10	4.10	4.10	4.10	4.10
	30%	4.60	4.62	4.62	4.62	4.62	4.64	4.10	4.10	4.10	4.10	4.10	4.10

6.1.3 Ammonia Toxicity Analysis

An analysis was performed on the model input and modeled results to determine whether the modeled ammonia concentrations exceeded EPA criteria for ammonia toxicity (USEPA 1999). The EPA criteria are dependent on temperature and pH. Temperature was taken from the model output. Because pH is not included in the model, it was obtained from levels observed during the July 2006 monitoring event. The resulting criteria and the model-predicted ammonia concentrations are presented in Table 6-20. To obtain concentrations below the EPA ammonia toxicity, a WLA for ammonia was reduced. The ammonia loading from the Alma Plantation (LA0003034—subsegment 120102) was reduced. The WLA for this facility can be seen in Table 6-4. With this reduction, ammonia toxicity criteria will not be exceeded during critical conditions. These results do not require ammonia or organic nitrogen permit limits for the permits included in this document. If LDEQ determines there is no reasonable potential for a discharger to exceed the ammonia or organic nitrogen WLAs, then a permit may omit these parameters and still comply with this TMDL. The ammonia toxicity calculations are included in Appendix L.

Table 6-20. Predicted ammonia concentration and calculated critical criteria

Subsegment	Predicted ammonia (mg/L)		Calculated critical criteria (mg/L)	
	Minimum	Maximum	Minimum	Maximum
120102	1.16	1.25	1.68	1.68
120103	0.08	1.13	0.48	1.93
120105	0.05	1.17	1.32	1.32
120106	0.00	0.42	0.62	0.62
120107	0.00	0.07	1.87	1.87
120109	0.02	0.05	1.37	1.74
120110	0.01	0.07	1.61	1.61

6.2 Nutrient TMDLs

Nutrients can enter a water system through surface runoff. Once they are in the environment, the most recognizable effect is algae blooms. The buildup of nutrients that leads to the blooms can occur over time even if the effects are not noticed in the short term. When algae die, the result is increased oxygen demand, which is detrimental to aquatic life.

The state's nutrient criteria are narrative and include the following language (LDEQ 2007):

> The naturally occurring range of nitrogen-phosphorous ratios shall be maintained. This range shall not apply to designated intermittent streams. To establish the appropriate range of ratios and compensate for natural seasonal fluctuations, the administrative authority will use site-specific studies to establish limits for nutrients. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters.

To accomplish this, water quality data were collected from non-nutrient impaired subsegments in the Terrebonne Basin. The data included total phosphorus, nitrate+nitrite, and TKN. The nitrate+nitrite and TKN were summed to obtain the total nitrogen concentration. Table 6-21 presents the average concentrations by monitoring location for the non-impaired subsegments. The minimum, mean, and maximum are presented for total phosphorus and total nitrogen.

Table 6-21. Nutrient concentrations in non-impaired subsegments

Subsegment	Subsegment name	Site ID	Total P (mg/L)	NO2+NO 3 (mg/L)	TKN (mg/L)	Total N (mg/L)	Total N/ total P ratio
120107	Upper Grand River and Lower Flat River	973	0.22	0.82	0.93	1.75	7.95
120108	False River	335	0.33	0.17	1.44	1.60	4.85
120110	Bayou Cholpe	976	0.22	0.17	0.97	1.14	5.18
120206	Grand Bayou and Little Grand Bayou	82	0.52	0.37	1.39	1.76	3.38
		Minimum	0.22	0.17	0.93	1.14	3.38
		Mean	0.32	0.38	1.18	1.56	5.34
		Maximum	0.52	0.82	1.44	1.76	7.95

The data in Table 6-21 were compared with the observed data for the nutrient-impaired subsegments in Table 6-22. The total nitrogen to total phosphorus ratio and mean concentrations in the nutrient listed subsegments are within the ratio and concentration ranges for the non-impaired subsegments. Because of this, no nutrient reductions were necessary for the subsegments listed in Table 6-22.

Table 6-22. Nutrient concentrations in the impaired subsegments in the upper Terrebonne Basin

Subsegment	Subsegment name	Total P (mg/L)	NO2+NO3 (mg/L)	TKN (mg/L)	Total N (mg/L)	Total N/ total P ratio
120102	Bayou Poydras	0.30	0.25	1.22	1.44	4.80
120103	Bayou Choctaw	0.24	0.32	1.01	1.31	5.46
120105	Chamberlin Canal	0.32	0.23	1.24	1.47	4.59
120106	Bayou Plaquemine	0.26	0.53	0.90	1.38	5.31
120109	Intracoastal Waterway	0.27	0.96	0.80	1.76	6.52

Because of the lack of flow data for the Terrebonne Basin, the monthly water yield (runoff in millimeters) was used to obtain TMDL loadings. The monthly water yields for the Central and South-central Climate Divisions were obtained from the Louisiana Office of State Climatology. The monthly water yield was divided by the number of days in the month to obtain runoff intensity (Table 6-23).

Table 6-23. Average water yields for climate divisions in the Terrebonne Basin

Climate division	Yearly average monthly water yield (millimeters)	Subsegments represented
Central	2.337	120102, 120103, 120105, 120109
South-central	2.378	120106

The nutrient TMDLs are presented in Table 6-24. The water yield was used with the mean reference stream concentration to determine the LA portion of the TMDL. Because no reductions to nutrients were required, it is assumed that the point sources may continue to discharge at their current concentration level of nutrients and not make any deleterious effect on water quality. Any increase in nutrient effluent concentrations could require additional monitoring and modeling and a revision to this TMDL.

Table 6-24. Summary of TMDLs for nutrients in the upper Terrebonne Basin

Subsegment	∑ WLA (lb/d)	∑ LA (lb/d)	MOS	FG (10%) (lb/d)	Total allowable loading (lb/d)	Percent reduction
Total phosphorus						
120102	0.000	0.146	Implicit	0.016	0.162	0.0
120103	0.000	0.373	Implicit	0.041	0.414	0.0
120105	0.000	0.276	Implicit	0.031	0.307	0.0
120106	0.000	0.017	Implicit	0.002	0.019	0.0
120109	0.000	0.430	Implicit	0.048	0.478	0.0
Total nitrogen						
120102	0.000	0.709	Implicit	0.079	0.788	0.0
120103	0.000	1.809	Implicit	0.201	2.010	0.0
120105	0.000	1.342	Implicit	0.149	1.491	0.0
120106	0.000	0.083	Implicit	0.009	0.092	0.0
120109	0.000	2.086	Implicit	0.232	2.317	0.0

7 FUTURE ACTIVITIES

7.1 TMDL Implementation Strategies

EPA Region 6 has funded a use attainability assessment (UAA) study for the *Development of Site-Specific Dissolved Oxygen Criteria for the Terrebonne Basin, Louisiana*. On January 31, 2008, the contractor (Tetra Tech, Inc.) submitted a draft report for EPA's review. In addition, the state is involved in analyzing available data for the Barataria and Terrebonne basin waters to evaluate and possibly revise the existing dissolved oxygen criterion.

Once LDEQ adopts and EPA approves the revised dissolved oxygen criteria, LDEQ will reassess the 303(d) listed subsegments for dissolved oxygen and nutrients in the Terrebonne Basin. If the reassessment of a subsegment indicates a subsegment is not impaired on the basis of revised criteria, if appropriate, the dissolved oxygen and nutrients TMDLs may be withdrawn, and EPA will publish a public notice. If the reassessment of a subsegment indicates that the subsegment is impaired on the basis of the revised criteria, if appropriate, the dissolved oxygen and nutrients TMDLs may be revised, and EPA will publish a public notice.

Reasonable assurance is needed that the water quality criterion will be attained. As a first step to implement these dissolved oxygen and nutrients TMDLs, it is recommended that LDEQ complete a reassessment of the 303(d)-listed subsegments in the Terrebonne Basin using the new adopted dissolved oxygen criteria to verify if the subsegment is not impaired or still considered impaired. WLAs will be implemented through Louisiana Pollutant Discharge Elimination System (LPDES) permit procedures. Part of the LAs might be implemented through the LDEQ 305(b) program and set priorities for the Clean Water Act section 319 program. BMPs from the implementation plan will be implemented throughout the subsegment. This approach will reduce the loadings and improve dissolved oxygen levels in the subsegment and subsequent downstream subsegments.

Hurricane Katrina made landfall on Monday, August 29, 2005, as a Category 4 hurricane. The storm brought heavy winds and rain to southeast Louisiana, breaching several levees and flooding up to 80 percent of New Orleans and large areas of coastal Louisiana. Both Hurricanes Katrina and Rita have caused a significant amount of change in sedimentation and water quality in southern Louisiana. Many wastewater treatment facilities were temporarily or permanently damaged. Some wastewater treatment facilities will be rebuilt; others will be relocated. Several federal and state agencies, including EPA and LDEQ, are engaged in collecting environmental data and assessing the recovery of the Gulf of Mexico waters.

The proposed TMDLs in this report were developed on the basis of pre- and post-hurricane water quality conditions. Some point sources in this TMDL have been updated with post-hurricane information, where available. Post-hurricane water quality conditions and other factors could delay the implementation of these proposed TMDLs, render some proposed TMDLs obsolete, or require modifications of the TMDLs. Although hurricane effects may be valid for some TMDLs, any deviation from the TMDLs should be justified using site-specific data or information.

7.2 Environmental Monitoring Activities

LDEQ uses funds provided under section 106 of the Clean Water Act and under the authority of the Louisiana Environmental Quality Act to run a program for monitoring the quality of Louisiana's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations using appropriate sampling methods and procedures to ensure the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term database for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program are used to develop the state's biennial section 305(b) report (*Water Quality Inventory*) and section 303(d) list of impaired waters.

LDEQ has implemented a watershed approach to surface water quality monitoring. Through the approach, the entire state is sampled on a 4-year cycle. Long-term trend monitoring sites at various locations on the large rivers and Lake Pontchartrain are sampled throughout the 4-year cycle. Sampling is conducted monthly to yield approximately 12 samples per site during each year the site is monitored. Sampling sites are located where they are considered representative of the waterbody. Under the current monitoring schedule, approximately one-half of the state's waters are newly assessed for section 305(b) and section 303(d) listing purposes during each biennial cycle; sampling occurs statewide each year. The 4-year cycle follows an initial 5-year rotation that covered all basins in the state according to the TMDL priorities.

Monitoring will allow LDEQ to determine whether there has been any improvement in water quality following TMDL implementation. As the monitoring results are evaluated at the end of each year, waterbodies might be added to or removed from the section 303(d) list of impaired waterbodies.

8 PUBLIC PARTICIPATION

Federal regulations require EPA to notify the public and seek comments concerning TMDLs that the Agency prepares. These TMDLs were developed under contract to EPA, and EPA held a public review period seeking comments, information, and data from the public and any other interested parties. The notice for the public review period was published in the *Federal Register* on October 25, 2007, and the review period closed on November 26, 2007.

LDEQ submitted the only comments received during the public comment period. Comments and additional information submitted during this public comment period were used to inform or revise this TMDL document. The comments and responses to these TMDLs, along with comments on similar TMDLs with the same public review period, will be included in the document: *EPA Responses to Comments for Dissolved Oxygen, Nutrients, pH, and Mercury TMDLs in the Red River, Sabine River, and Terrebonne Basins, Louisiana.*

EPA will submit the final TMDLs to LDEQ for implementation and incorporation into LDEQ's current water quality management plan.

REFERENCES

LDEQ (Louisiana Department of Environmental Quality). 2002. Office of Environmental Services Water Discharge Permit, Final: Discharges from Small Municipal Separate Storm Sewer Systems. Louisiana Department of Environmental Quality, Baton Rouge, LA.

LDEQ (Louisiana Department of Environmental Quality). 2004. *Water Quality Integrated Report*. Prepared pursuant to section 305(b) of the Federal Water Pollution Control Act. <http://www.deq.louisiana.gov/protal/Default.aspx?tabid=2201>. Accessed April 5, 2007.

LDEQ (Louisiana Department of Environmental Quality). 2005. *Standard Operating Procedure for Louisiana Total Maximum Daily Load Technical Procedures*. 9th revision. Louisiana Department of Environmental Quality Office of Environmental Assessment, Baton Rouge, LA.

LDEQ (Louisiana Department of Environmental Quality). 2007. Title 33, Environmental Quality; Part IX, Water Quality; Subpart 1, Water Pollution Control. <http://www.deq.louisiana.gov/portal/LinkClick.aspx?link=planning%2fregs%2ftitle33%2f33v09.pdf&tabid=1674>. Accessed September 14, 2007.

Mason, A.E., Y. Xu, P. Saksa, A. Viosca, J.M. Grace, J. Beebe, and R. Stich. 2007. Streamflow and Nutrient Dependence of Temperature Effects on Dissolved Oxygen in Low-order Forest Streams. In *Watershed Management to Meet Water Quality Standards and TMDLs (Total Maximum Daily Load): Proceedings of the 10–14 March 2007, San Antonio, TX 701P0207*. American Society of Agricultural and Biological Engineers, St. Joseph, MI.

Murphy, S. 2005. *General Information on Dissolved Oxygen*. City of Boulder/U.S. Geological Survey Water Quality Monitoring. <http://bcn.boulder.co.us/basin/data/BACT/info/DO.html>. Accessed April 8, 2007.

Scorecard. 2005. Pollutants or Environmental Stressors Impairing Water Quality. Scorecard: The Pollution Information Site. <http://www.scorecard.org/env-releases/def/cwa_cause_class_def.html>. Accessed April 8, 2007.

USEPA (U.S. Environmental Protection Agency). 1991. *Guidance for Water Quality-based Decisions: The TMDL Process*. EPA 440/-4-91-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 1999. *1999 Update of Ambient Water Quality Criteria for Ammonia*. EPA 822-R-99-014. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2000. Storm Water Phase II Final Rule. (Fact sheet). EPA 833-F-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Wiland Consulting, Inc. 2005. *LA-QUAL for Windows. User's Manual*. Model Version 7.02. Prepared for Louisiana Department of the Environment, Watershed Support Division, Engineering Section, by Wiland Consulting, Inc., Austin, TX.